

100

ANTENNA

112

AMPLIFIER
(OPTIONAL)

116

FREQUENCY
MULTIPLIER
(OPTIONAL)

110

FREQUENCY
MODULATED
SIGNAL

108

VOLTAGE
CONTROLLED
OSCILLATOR

106

AMPLIFIER
(OPTIONAL)

114

FILTER
(OPTIONAL)

104

INFORMATION
SIGNAL

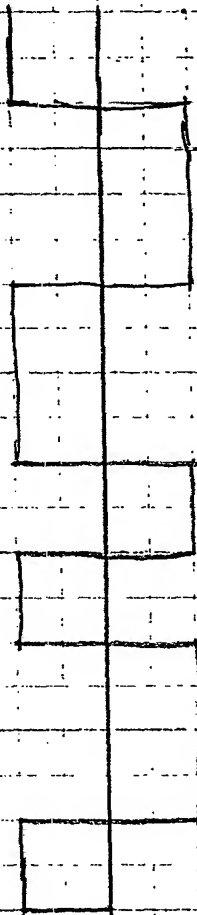
102

FREQUENCY MODULATION CIRCUIT

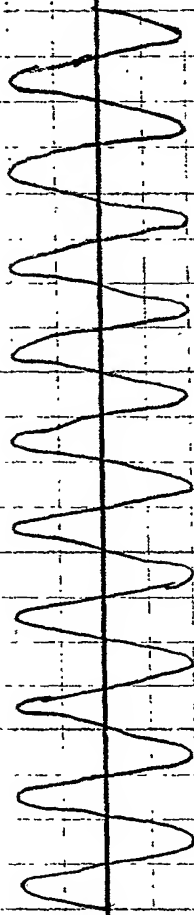
FIG. 1
(RELATED ART)

M.

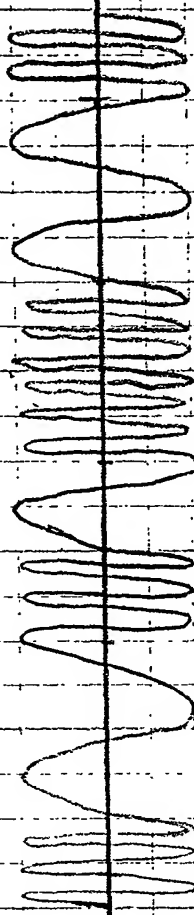
INFORMATION
SIGNAL
102



OSCILLATOR
SIGNAL
200



MODULATED
SIGNAL
A.D.B



FREQUENCY MODULATION WAVEFORMS

FIG. 2
(RELATED ART)

DATE: / /

300

ANTENNA

316

AMPLIFIER
(OPTIONAL)

304

318

306

312

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320

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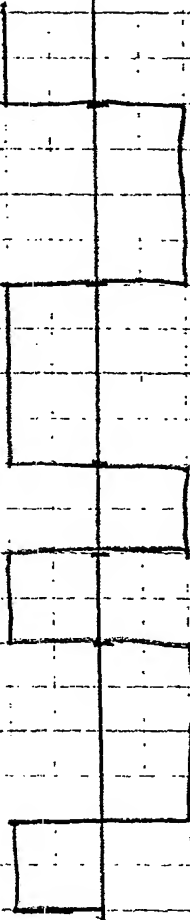
306

310

302

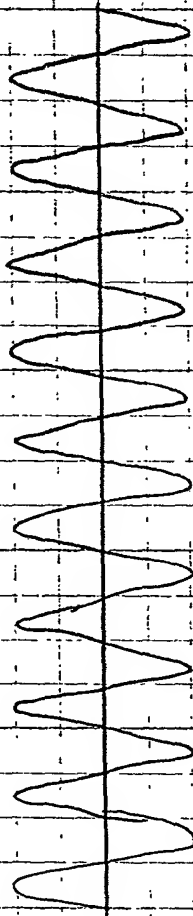
INFORMATION
SIGNAL
302

FIG. 4A



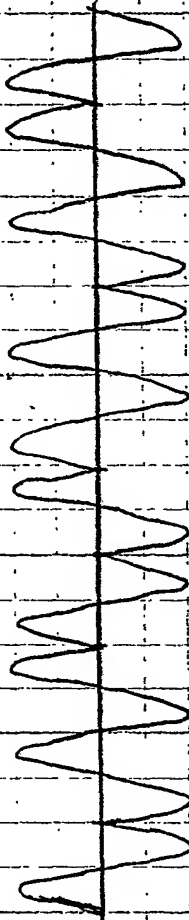
OSCILLATOR
SIGNAL
308

FIG. 4B



PHASE
MODULATED
SIGNAL
312

FIG. 4C



PHASE MODULATION WAVEFORMS

FIG. 4
(RELATED ART)

FIG. 5

500

INFORMATION
SIGNAL
502

AMPLIFIER
(OPTIONAL)
504

FILTER
(OPTIONAL)
510

AMPLITUDE
MODULATED
SIGNAL
512

MULTIPLIER
510

FREQUENCY
MULTIPLIER
(OPTIONAL)
514

AMPLIFIER
(OPTIONAL)
520

ANTENNA
516

OSCILLATOR
506

AMPLITUDE MODULATION CIRCUIT

FIG. 5
(RELATED ART)

[illegible]

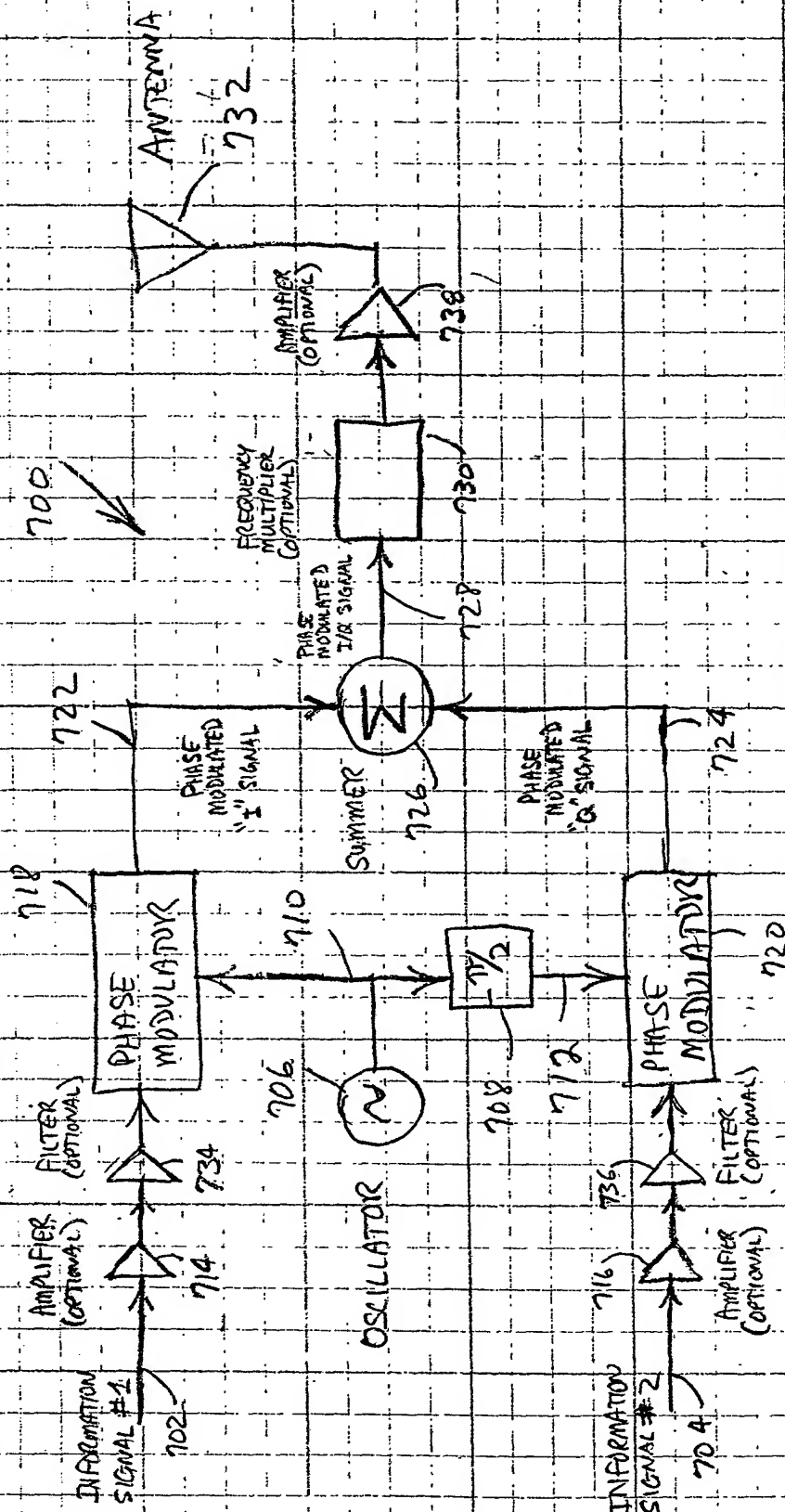
SIGNAL
508

Fig. 6B

Fig. 6c

AMPLITUDE MODULATION

FIG. 6
(RELATED ART)

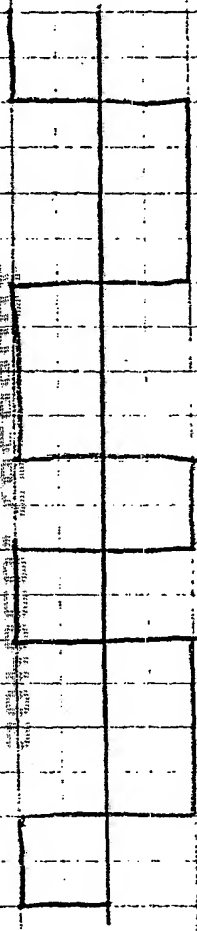


IN-PHASE/QUADRATURE PHASE MODULATION CIRCUIT

FIG. 7
(RELATED ART)

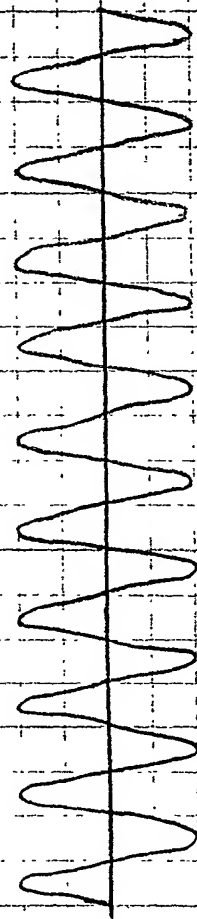
INFORMATION
SIGNAL #1
702

FIG. 8A



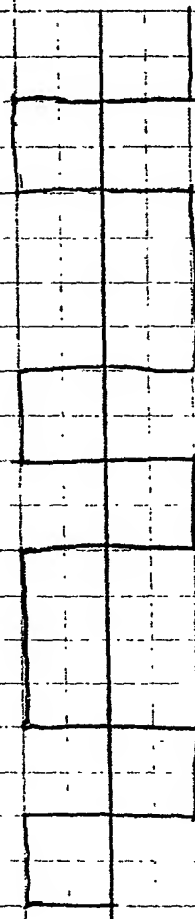
OSCILLATOR
SIGNAL #1
710

FIG. 8B



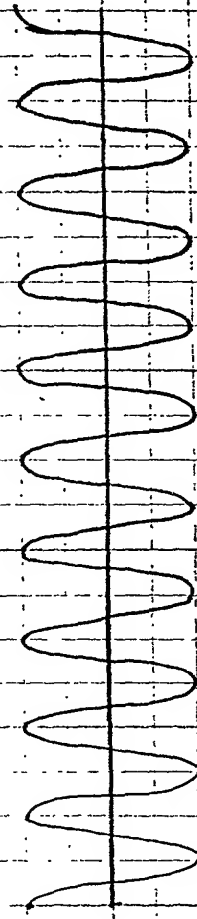
INFORMATION
SIGNAL #2
704

FIG. 8C



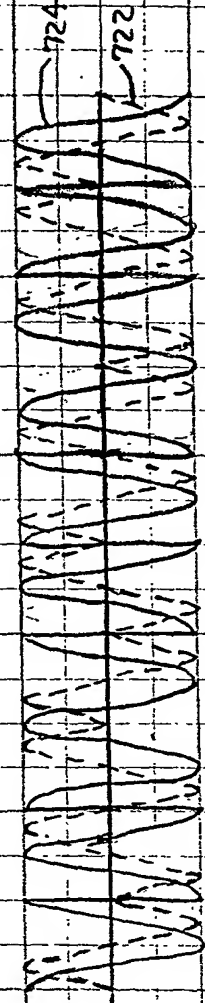
OSCILLATOR SIGNAL #1
WITH 90° PHASE SHIFT
712

FIG. 8D



MODULATED SIGNALS
(NOT SHOWN SUMMED)

FIG. 8E



IN PHASE/QUADRATURE MODULATION

FIG. 8 (RELATED ART)

Transmitter

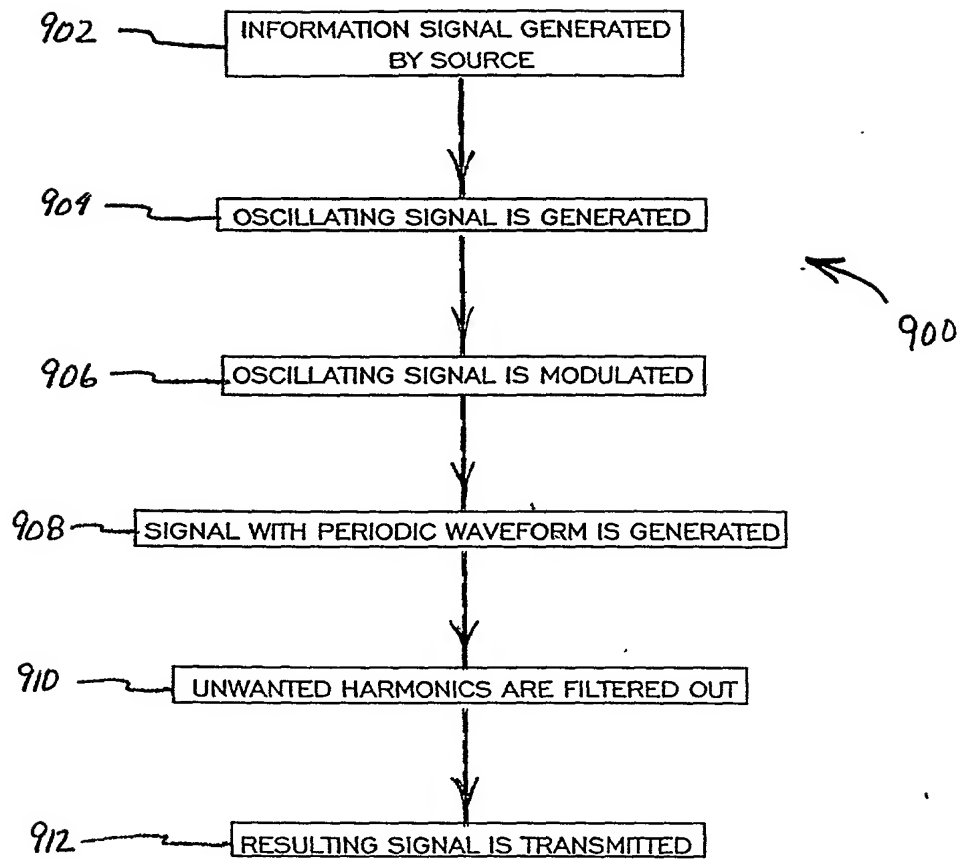
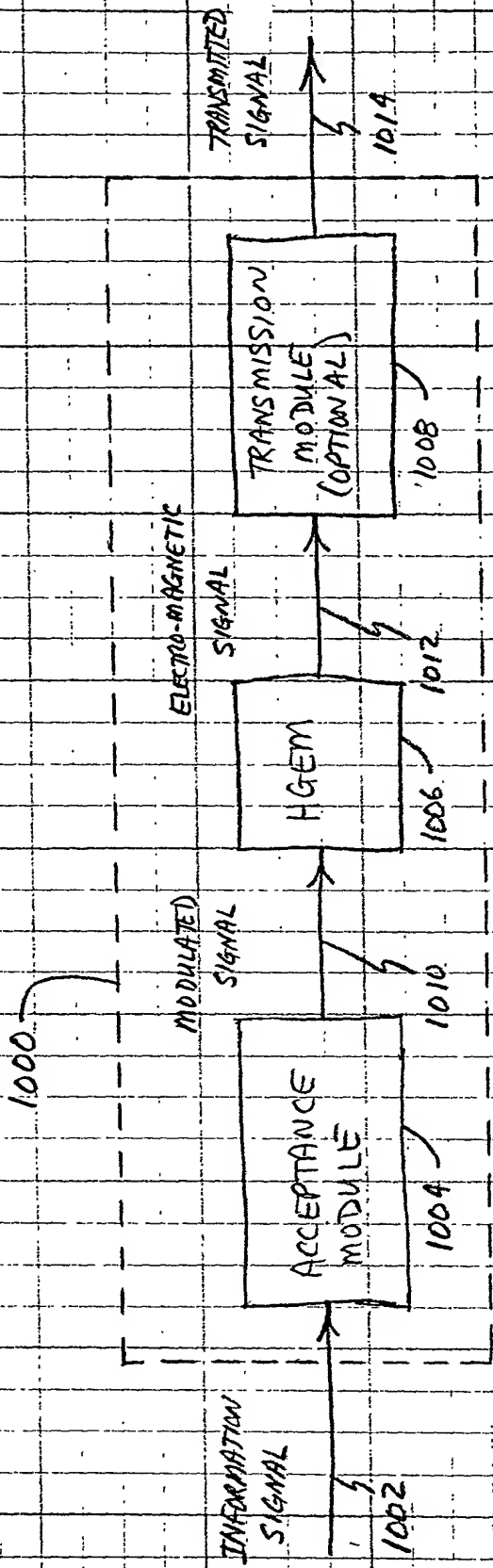


FIG. 9



TRANSMITTER EMBODIMENT

FIG. 10

Frequency Modulation Mode

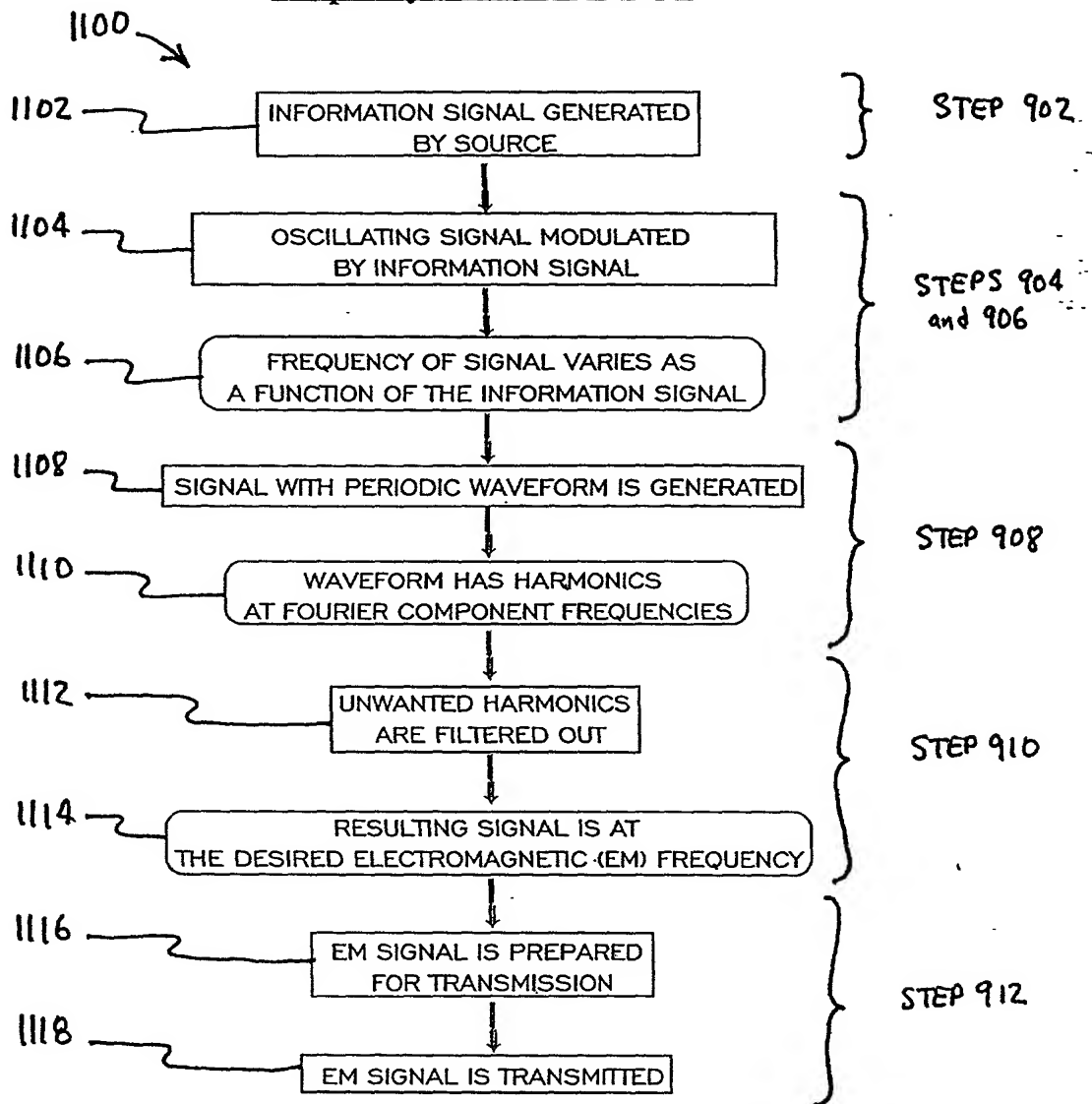


FIG. 11

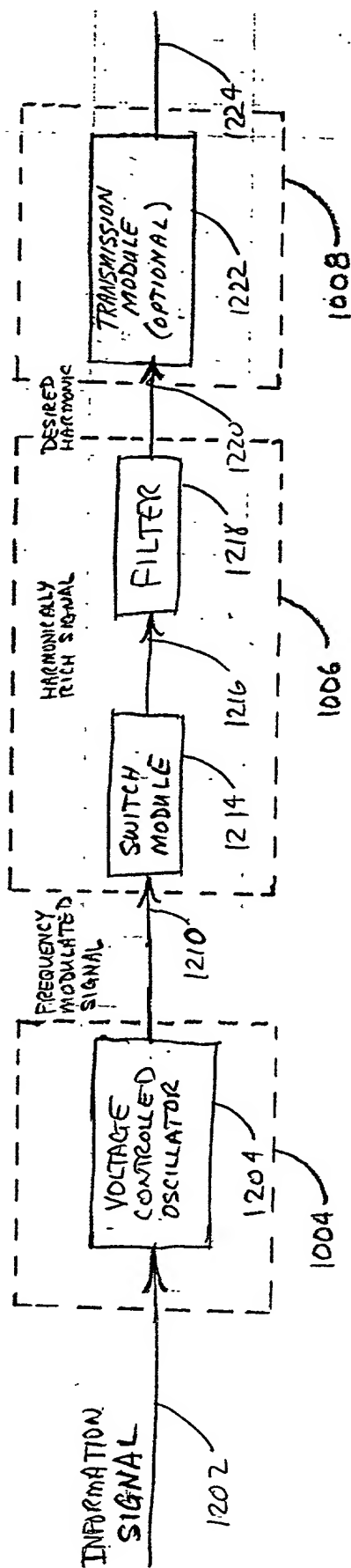


FIG. 12

1300

Phase Modulation Mode

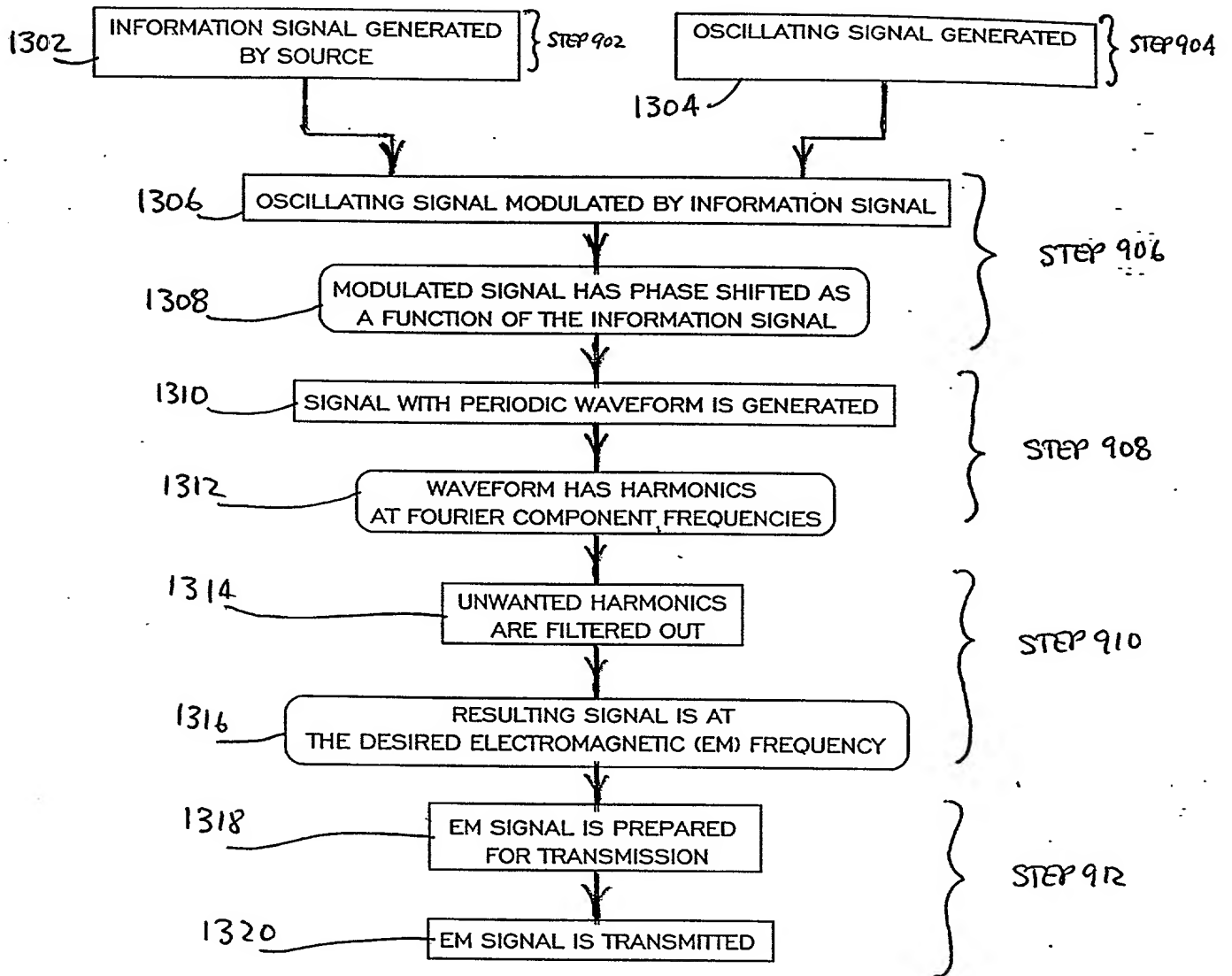


FIG. 13

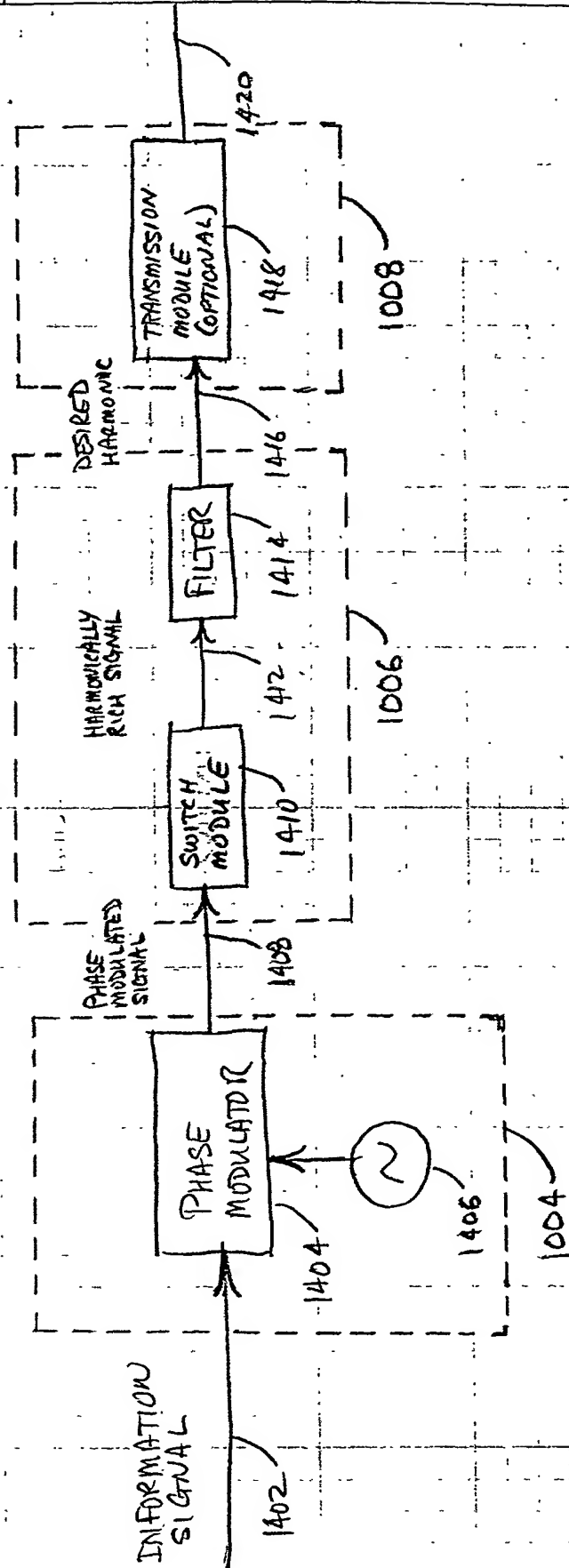


FIG. 14

Amplitude Modulation Mode

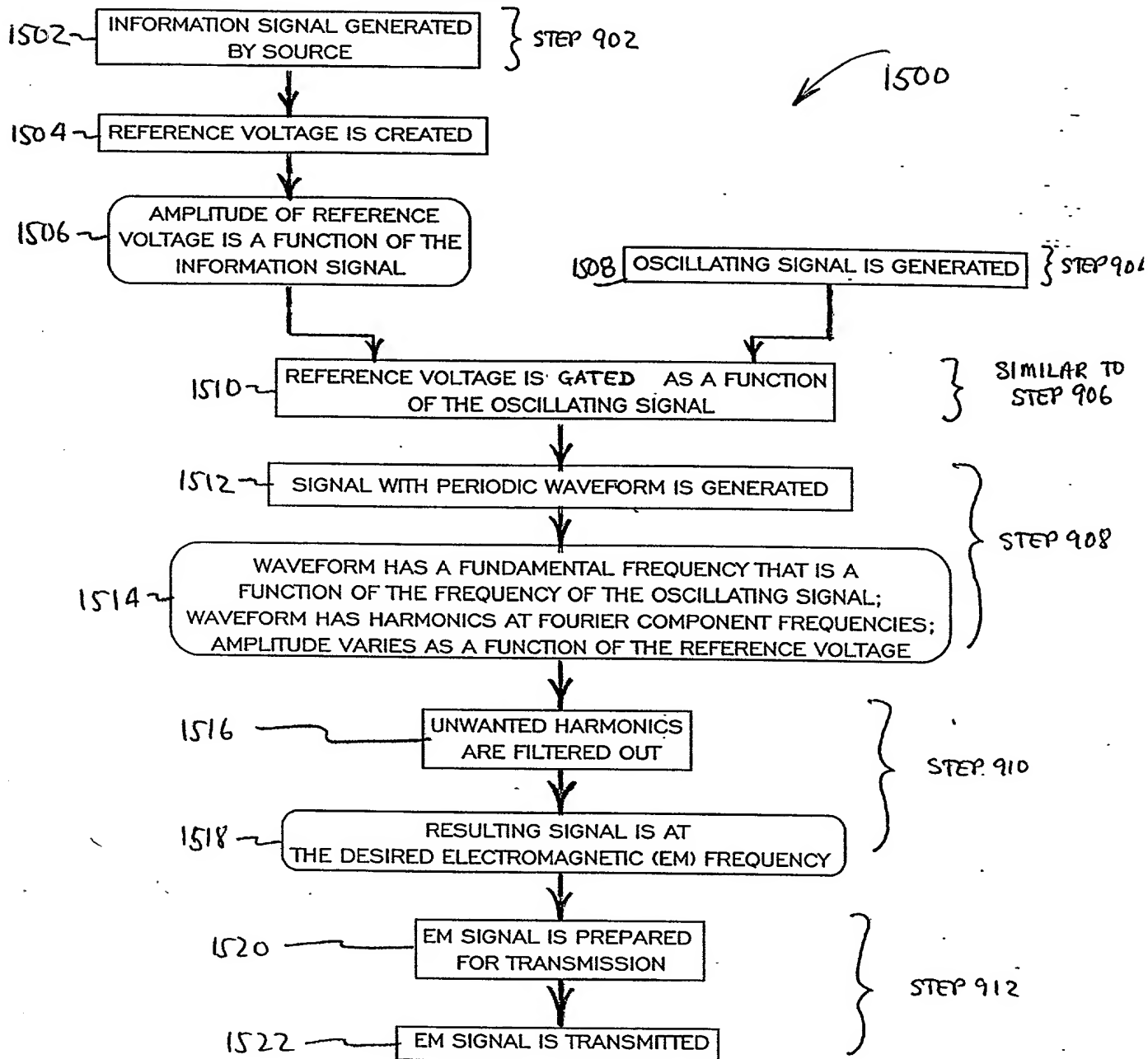


FIG. 15

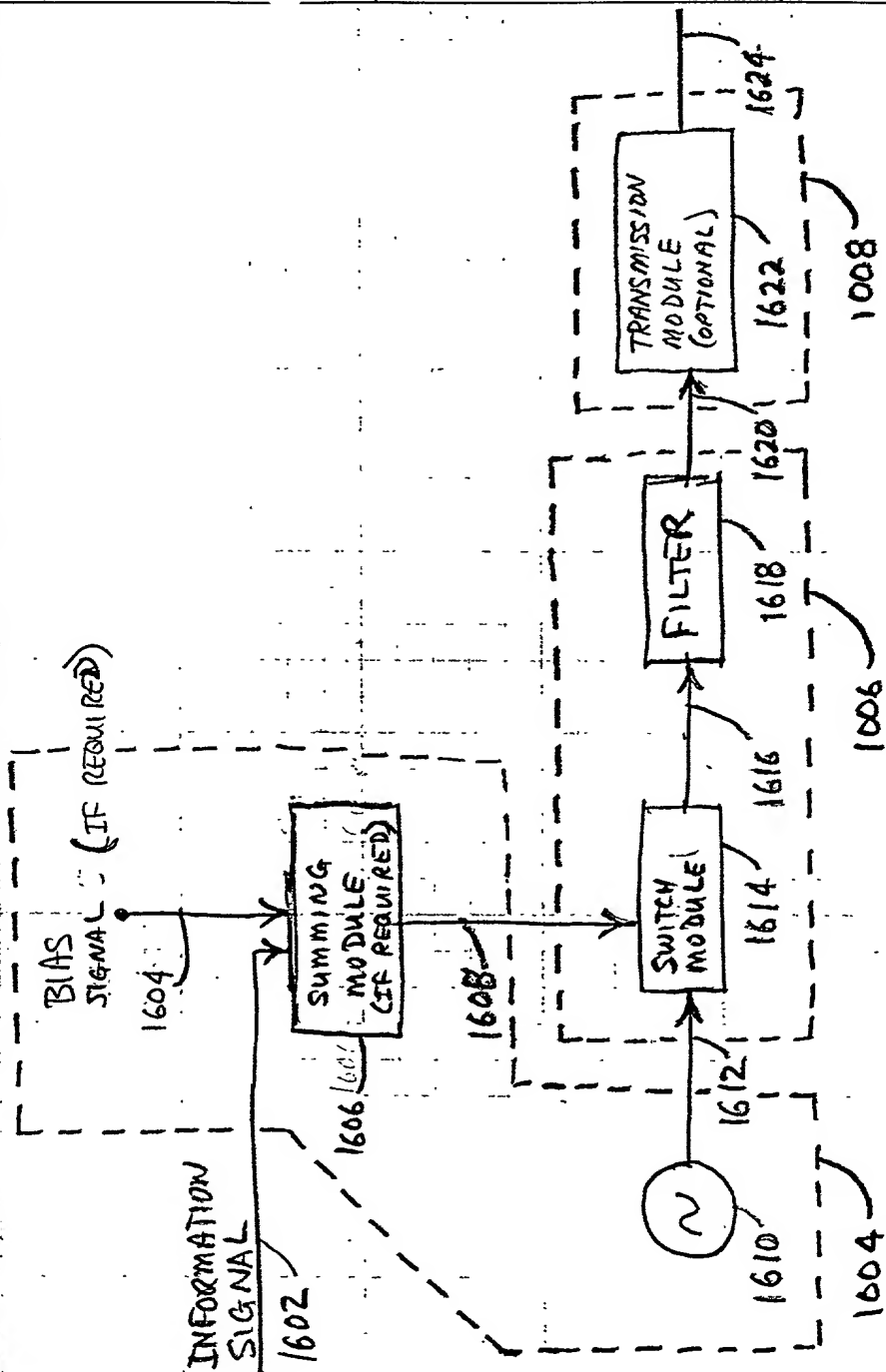


FIG. 16

I/Q Modulation Mode

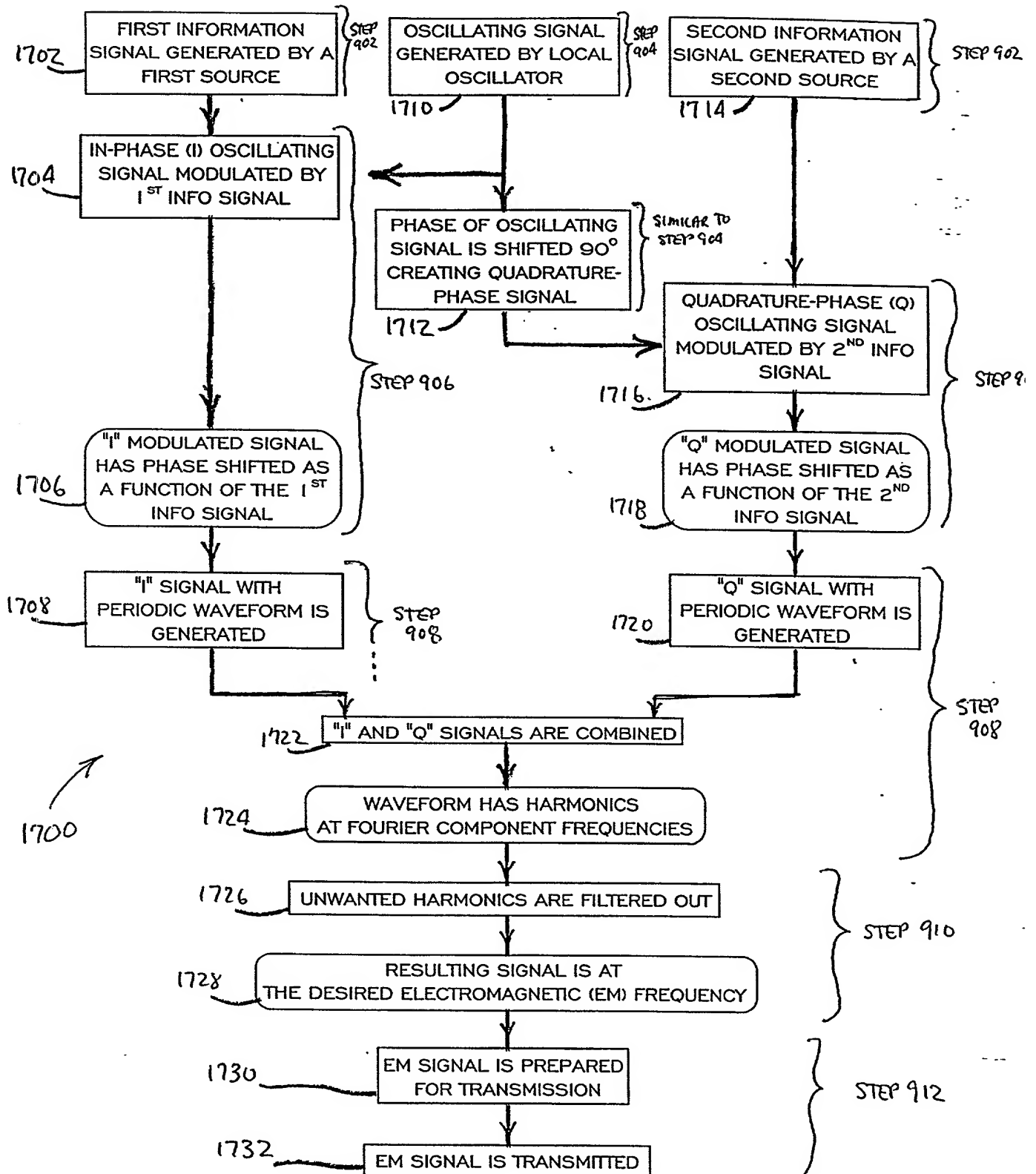
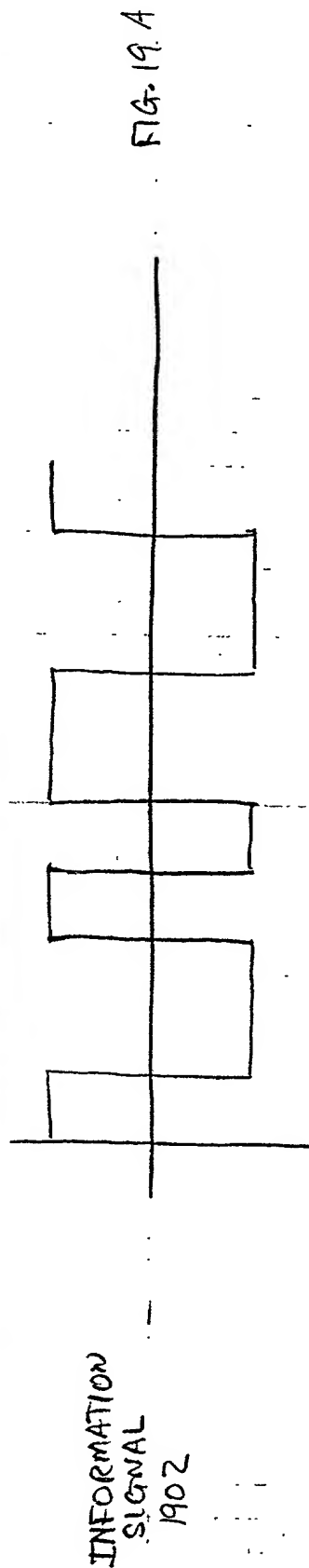
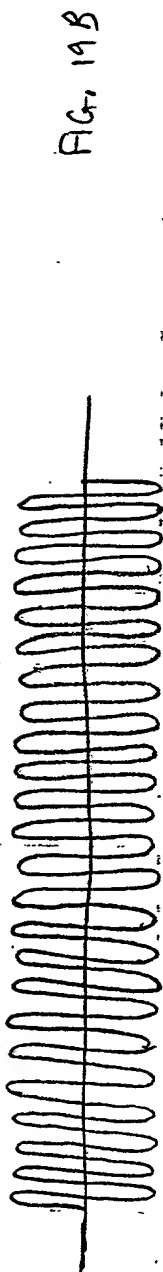


FIG 17



OSCILLATING
SIGNAL
1904



MODULATED SIGNAL
(SHOWN AS FM)



SIGNAL WITH
RECTANGULAR WAVEFORM
(SHOWN AS SQUARE WAVE)
1908



1961
SEP 26. 1961

FIG. 19

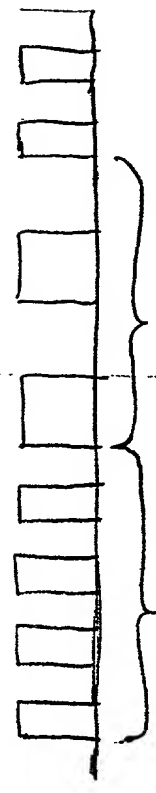
3

13-782 500 SHEETS, RULER, 5 SQUARE
42-381 100 SHEETS, RULER, 5 SQUARE
42-382 100 SHEETS, RULER, 5 SQUARE
42-383 100 SHEETS, RULER, 5 SQUARE
42-384 100 SHEETS, RULER, 5 SQUARE
42-385 100 SHEETS, RULER, 5 SQUARE
42-386 100 SHEETS, RULER, 5 SQUARE
42-387 100 SHEETS, RULER, 5 SQUARE
42-388 100 SHEETS, RULER, 5 SQUARE
42-389 100 SHEETS, RULER, 5 SQUARE
42-390 100 SHEETS, RULER, 5 SQUARE
42-391 100 SHEETS, RULER, 5 SQUARE
42-392 100 SHEETS, RULER, 5 SQUARE
42-393 100 SHEETS, RULER, 5 SQUARE
42-394 100 SHEETS, RULER, 5 SQUARE
42-395 100 SHEETS, RULER, 5 SQUARE
42-396 100 SHEETS, RULER, 5 SQUARE
42-397 100 SHEETS, RULER, 5 SQUARE
42-398 100 SHEETS, RULER, 5 SQUARE
42-399 100 SHEETS, RULER, 5 SQUARE
42-400 100 SHEETS, RULER, 5 SQUARE



Made in U.S.A.

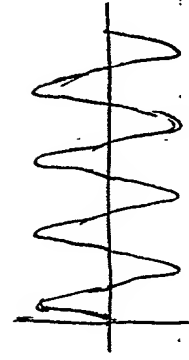
PERIODIC WAVEFORM
(SHOWN EXPANDED)
(SHOWN AS SQUARE WAVE)
1910



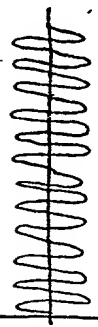
SIGNAL A
SEE FIGS. 19F
1912

FIG. 19E

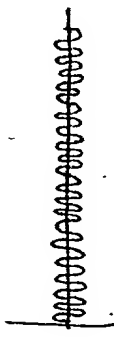
HARMONICS OF SIGNAL A
(SHOWN SEPARATELY - ALL
OCCUR SIMULTANEOUSLY)
(SHOWN EXPANDED)
1912



FUNDAMENTAL
FREQUENCY (f_1)
1912a



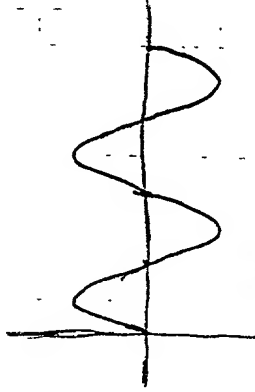
THIRD HARMONIC
(3 TIMES f_1)
1912b



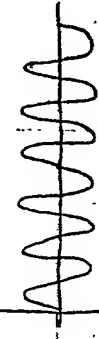
FIFTH HARMONIC
(5 TIMES f_1)
1912c

FIGS. 19F

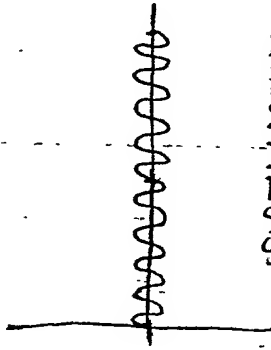
HARMONICS OF SIGNAL B
(SHOWN SEPARATELY - ALL
OCCUR SIMULTANEOUSLY)
(SHOWN EXPANDED)
1914



FUNDAMENTAL
FREQUENCY (f_1)
1914a



THIRD HARMONIC
(3 TIMES f_1)
1914b



FIFTH HARMONIC
(5 TIMES f_1)
1914c

FIGS. 19G

FIG. 19 (cont)

National® Brand

13-782	500 SHEETS, FILLER	5 SQUARE
12-381	60 SHEETS EYE-EASE	5 SQUARE
12-382	100 SHEETS EYE-EASE	5 SQUARE
12-389	200 SHEETS EYE-EASE	5 SQUARE
12-392	100 RECYCLED WHITE	5 SQUARE
12-399	200 RECYCLED WHITE	5 SQUARE

M. A. A.

HARMONICS OF
SIGNAL A 4-B
(SHOWN SIMULTANEOUSLY
BUT NOT SUMMED)
(SHOWN EXPANDED)
9/16

1912

914

FILTERED
SIGNAL A+B
(SHOWN EXPANDED)

1918

1912c

1914c

Fig. 1941

FIG. 19 I.

Fig. 19 (cont)

INFORMATION
SIGNAL
2102

FIG. 21A

OSCILLATING
CARRIER
SIGNAL
308

FIG. 21B

PHASE
MODULATED
SIGNAL
2104

FIG. 21C

PHASE MODULATION OF ANALOG SIGNAL
FIG. 21 (RELATED ART)

INFORMATION
SIGNAL
2202

FIG. 22 A

OSCILLATING
CARRIER
SIGNAL
508

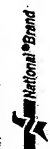
FIG. 22 B

AMPLITUDE
MODULATED
SIGNAL
2204

FIG. 22 C

AMPLITUDE MODULATION OF ANALOG SIGNAL
FIG. 22 (RELATED ART)

13-782 500 SHEETS FILLER 5 SQUARE
42-381 100 SHEETS FILLER 5 SQUARE
42-382 100 SHEETS FILLER 5 SQUARE
42-383 100 SHEETS FILLER 5 SQUARE
42-384 100 SHEETS FILLER 5 SQUARE
42-385 100 SHEETS FILLER 5 SQUARE
42-386 100 SHEETS FILLER 5 SQUARE
42-387 100 SHEETS FILLER 5 SQUARE
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42-391 100 SHEETS FILLER 5 SQUARE
42-392 100 SHEETS FILLER 5 SQUARE
42-393 100 SHEETS FILLER 5 SQUARE
42-394 100 SHEETS FILLER 5 SQUARE
42-395 100 SHEETS FILLER 5 SQUARE
42-396 100 SHEETS FILLER 5 SQUARE
42-397 100 SHEETS FILLER 5 SQUARE
42-398 100 SHEETS FILLER 5 SQUARE
42-399 100 SHEETS FILLER 5 SQUARE
42-400 100 SHEETS FILLER 5 SQUARE



Made in U.S.A.

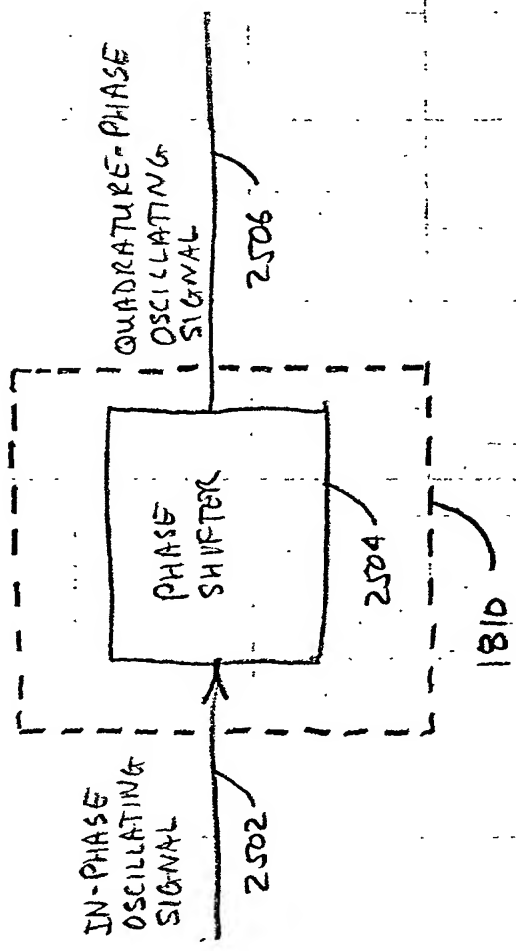


FIG. 25

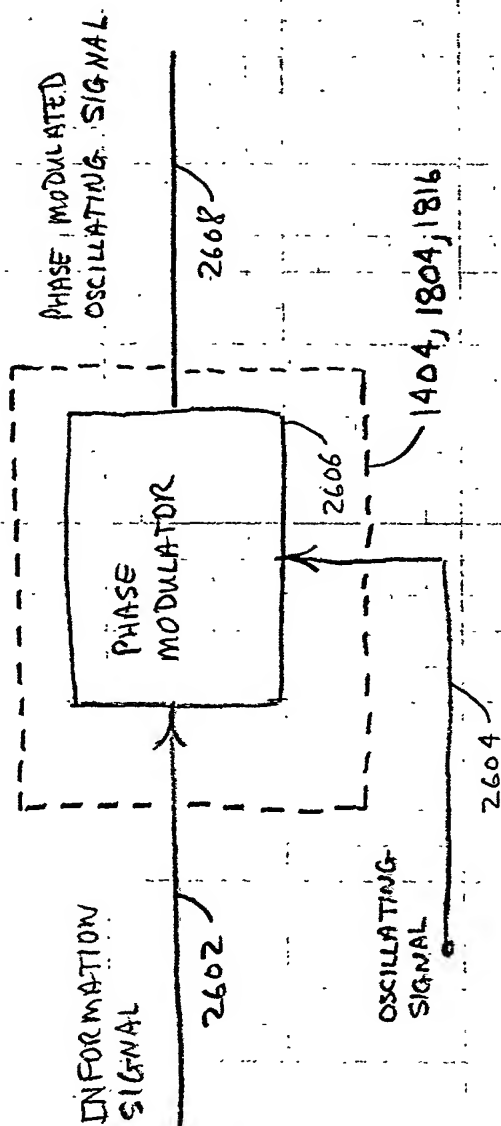


FIG. 26

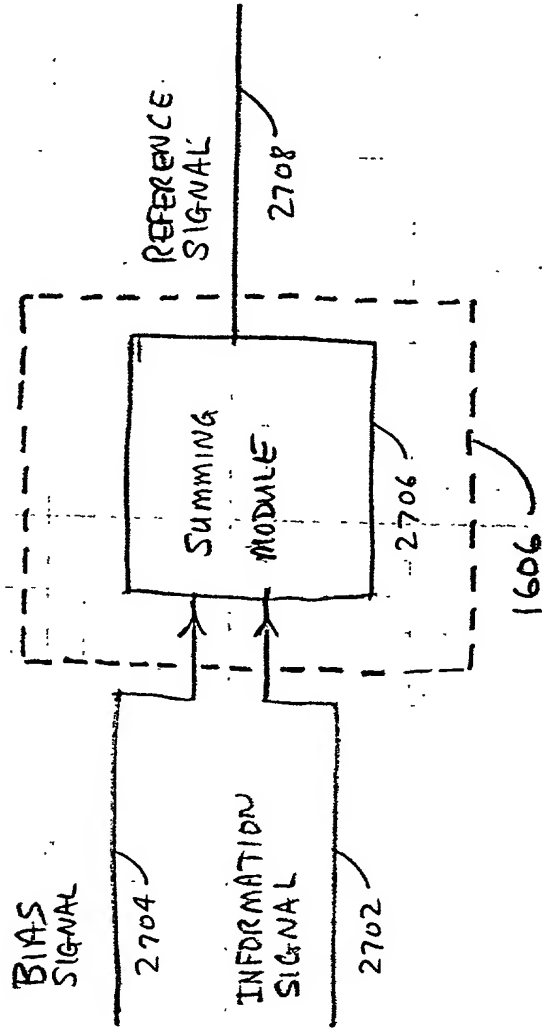


FIG. 27

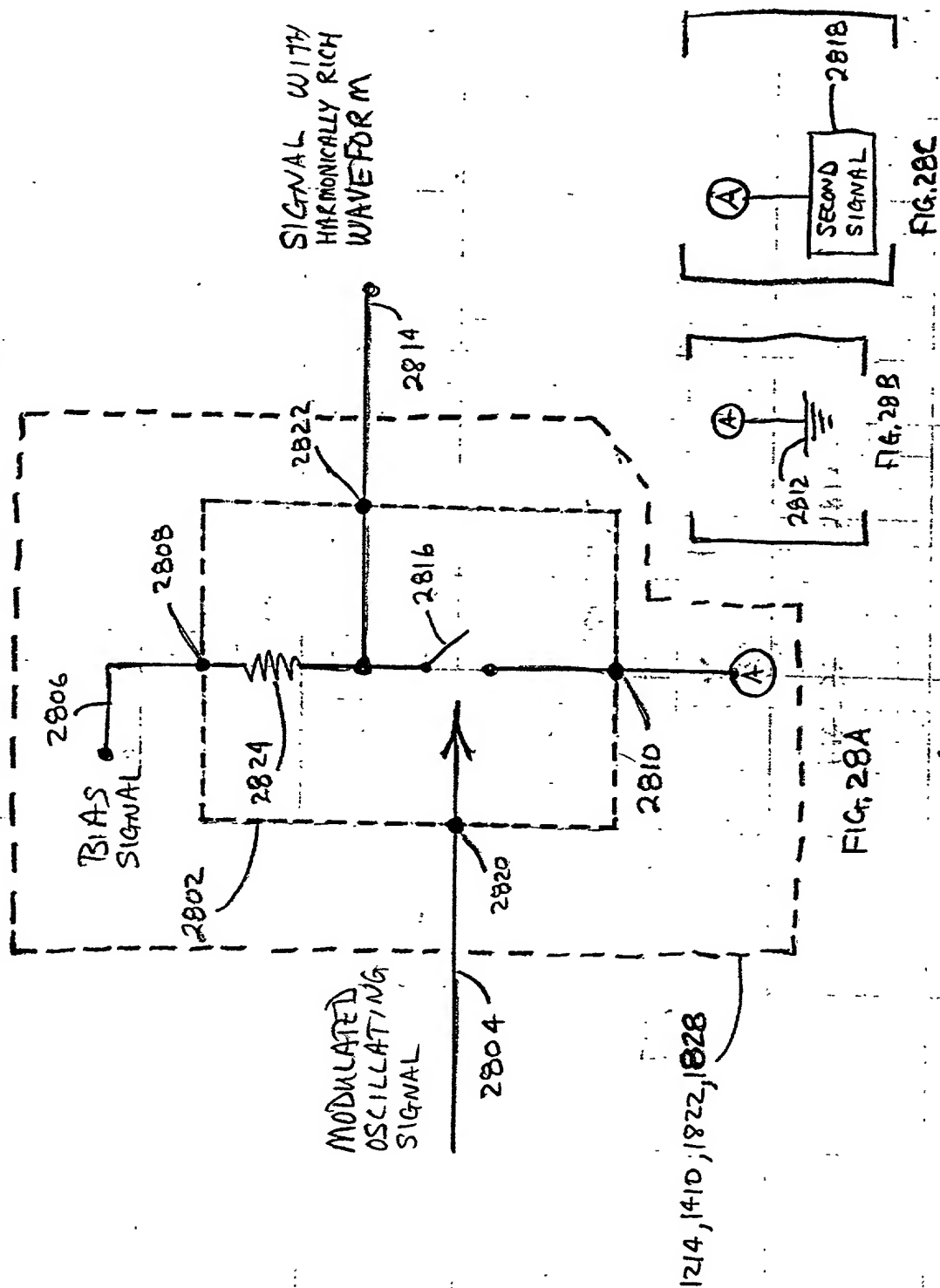


FIG. 28

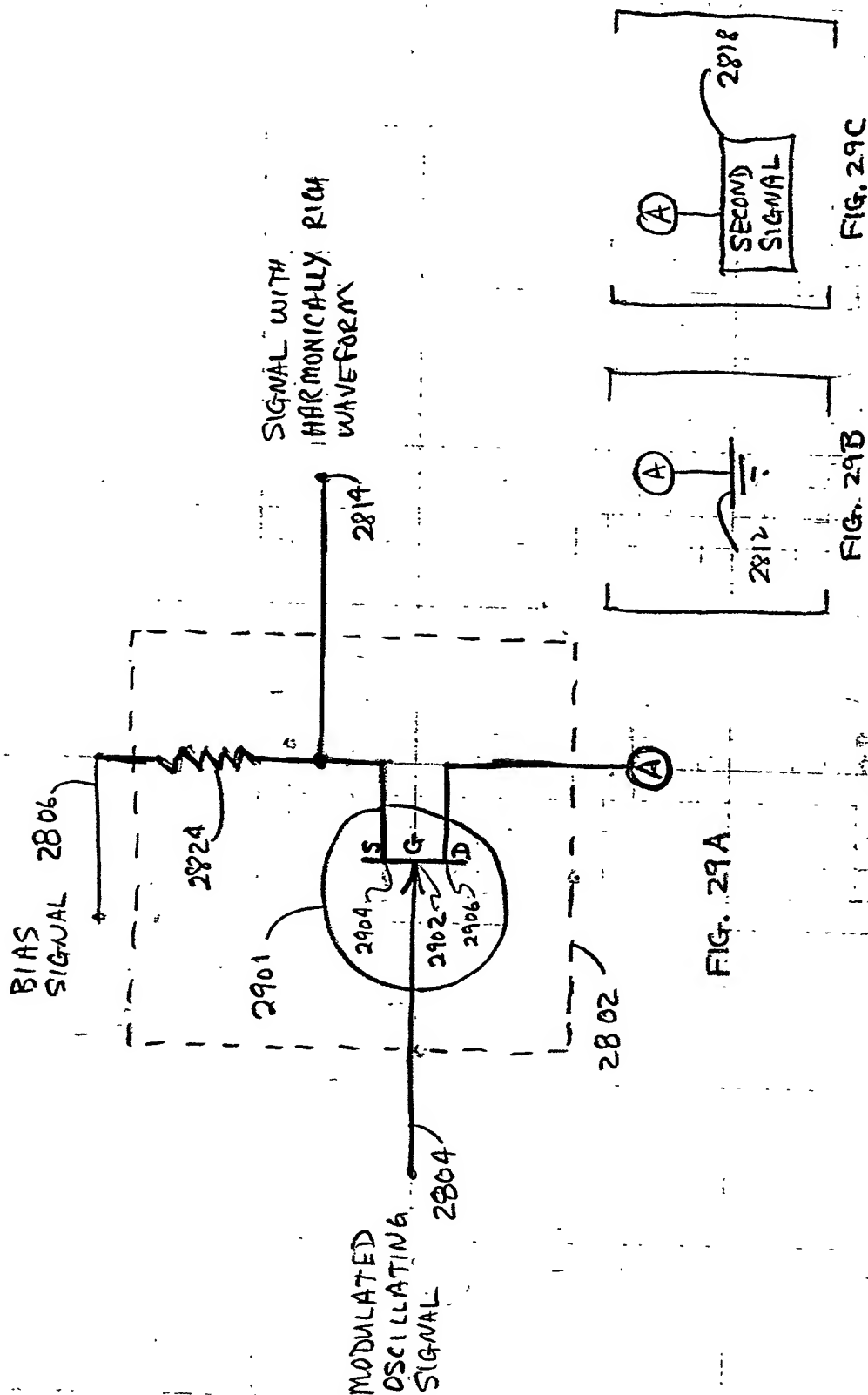


FIG. 29

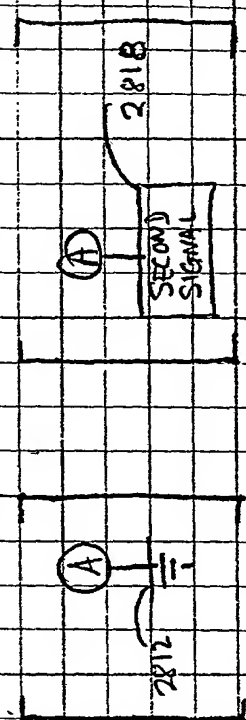
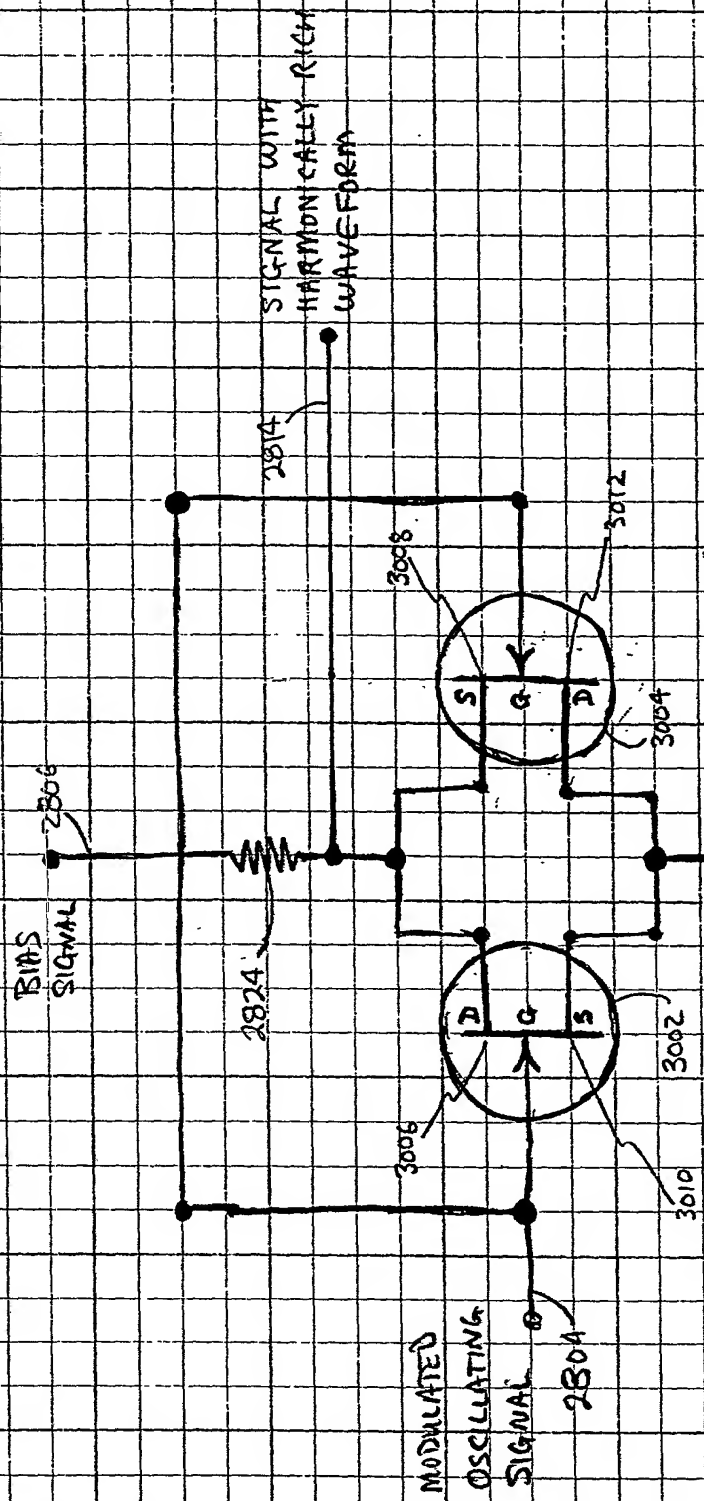
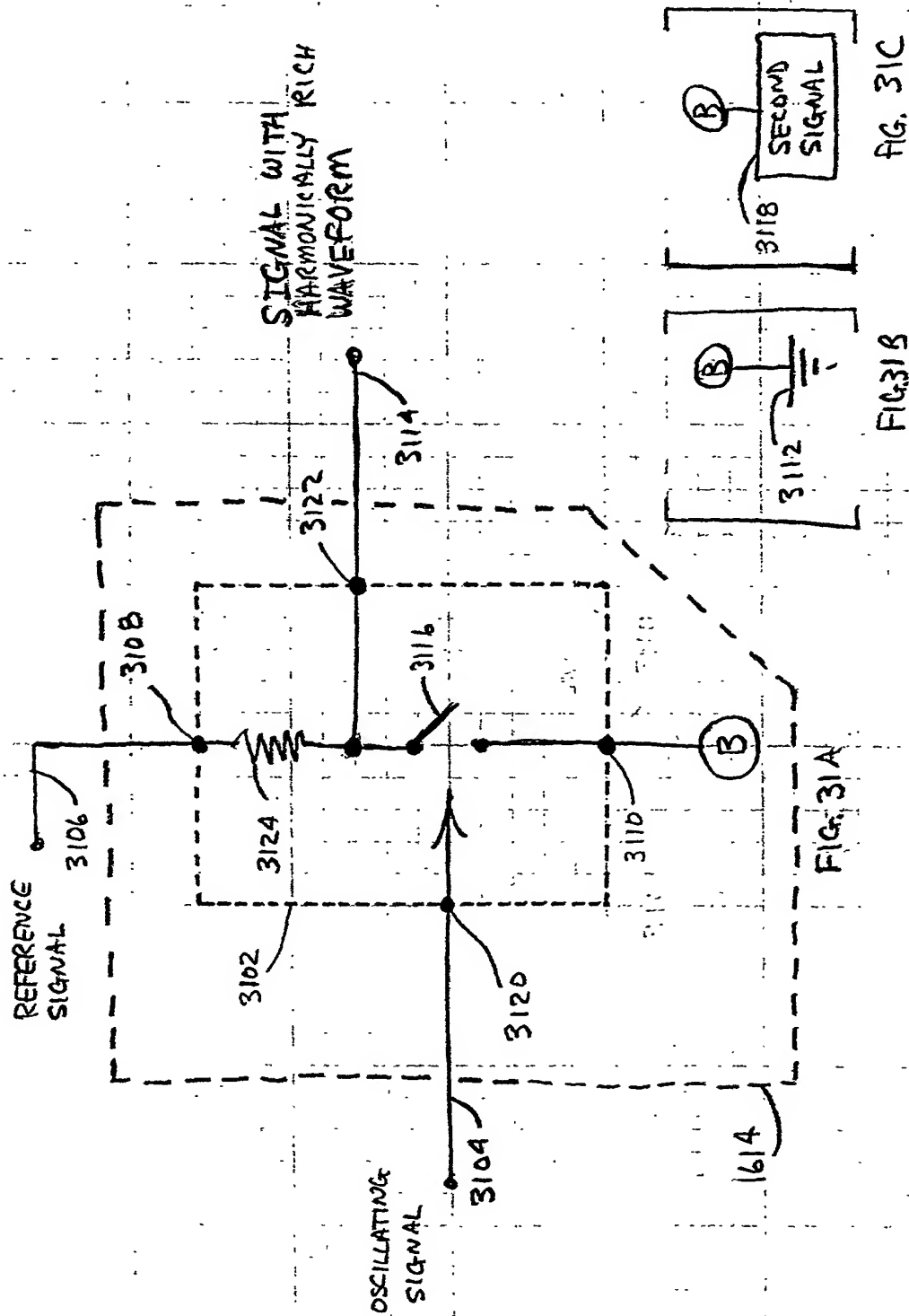


FIG. 30C

FIG. 30



॥ ॐ ॥

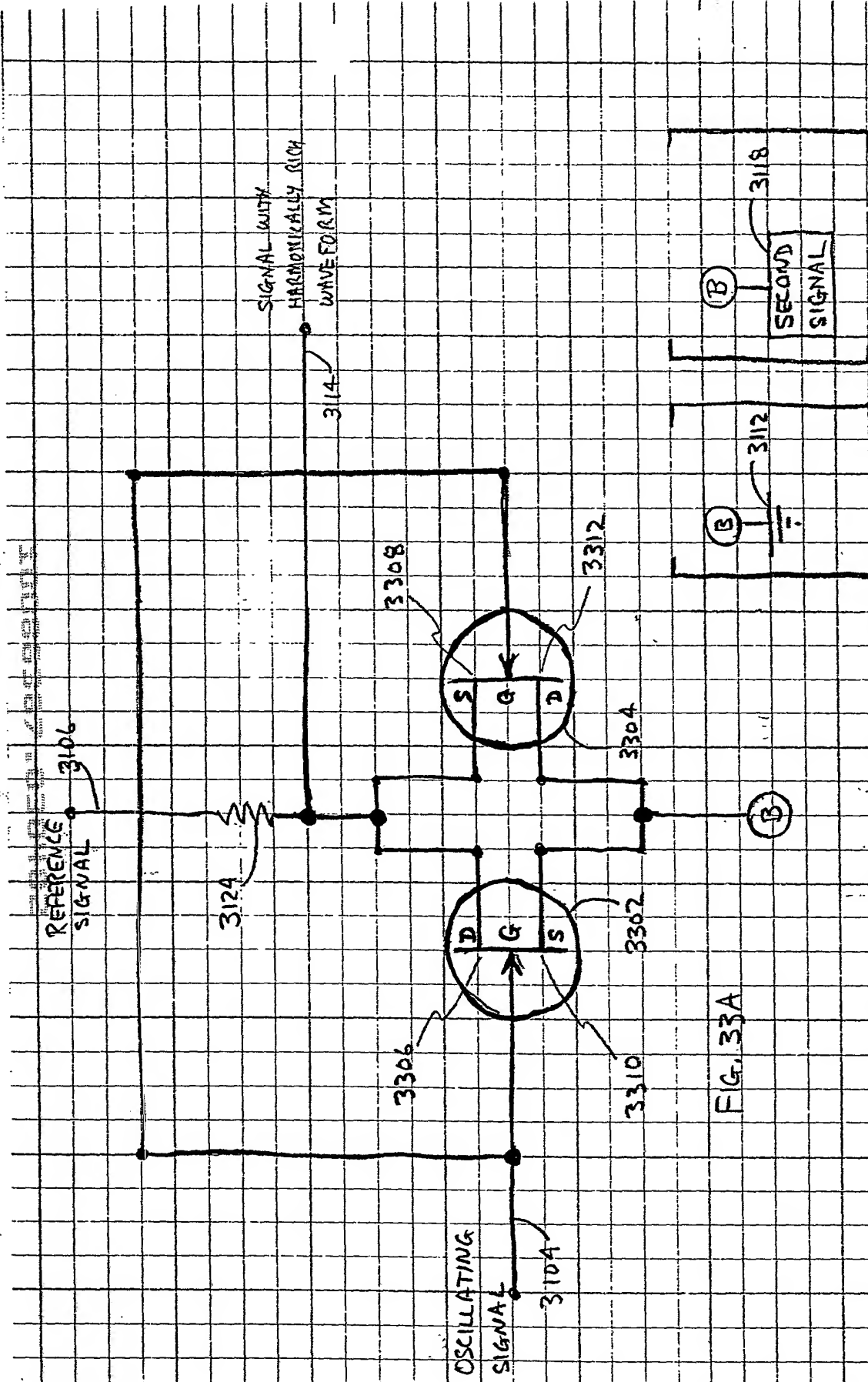


FIG. 33A

FIG. 33B

FIG. 33C

FIG. 33

13-782 500 SHEETS FILLER 5 SQUARE
 42-382 500 SHEETS FILLER 5 SQUARE
 42-382 100 SHEETS EVEREAD'S 5 SQUARE
 42-382 200 SHEETS EVEREAD'S 5 SQUARE
 42-382 200 RECYCLED WHITE 5 SQUARE
 42-382 200 RECYCLED WHITE 5 SQUARE
 Made in U.S.A.



HARMONICALLY RICH
"I" SIGNAL

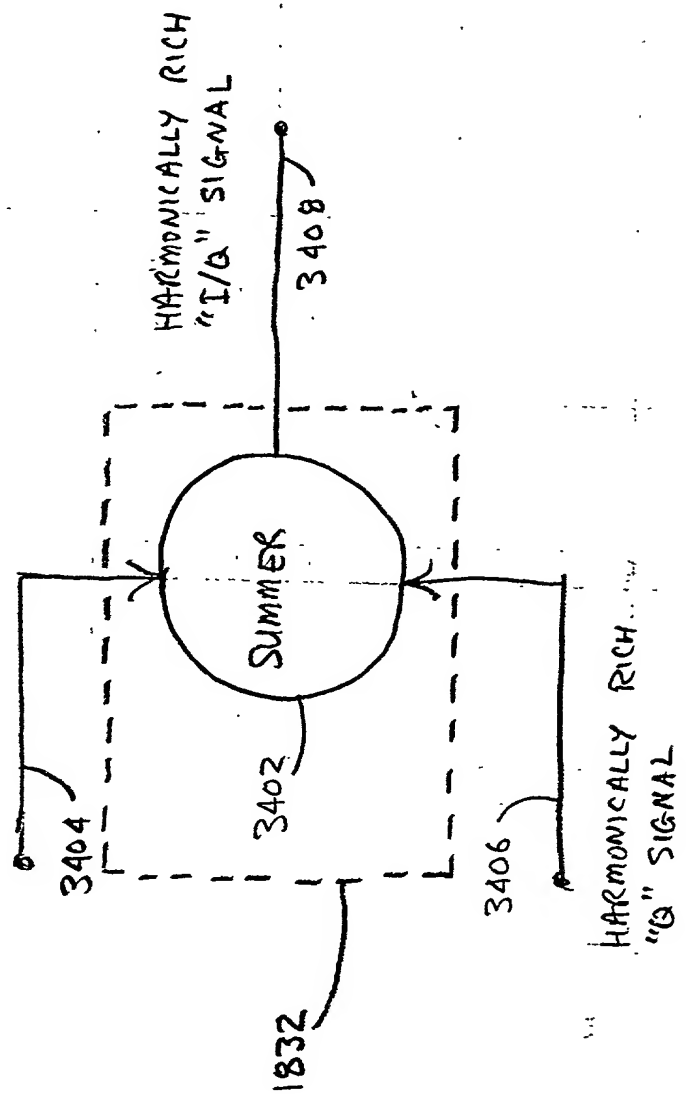


FIG. 34



13-782 500 SHEETS, FILLER 5 SQUARE
42-381 50 SHEETS, EYE-EASE® 5 SQUARE
42-382 100 SHEETS, EYE-EASE® 5 SQUARE
42-383 200 SHEETS, EYE-EASE® 5 SQUARE
42-382 100 RECYCLED WHITE 5 SQUARE
42-389 200 RECYCLED WHITE 5 SQUARE

Made in U. S. A.

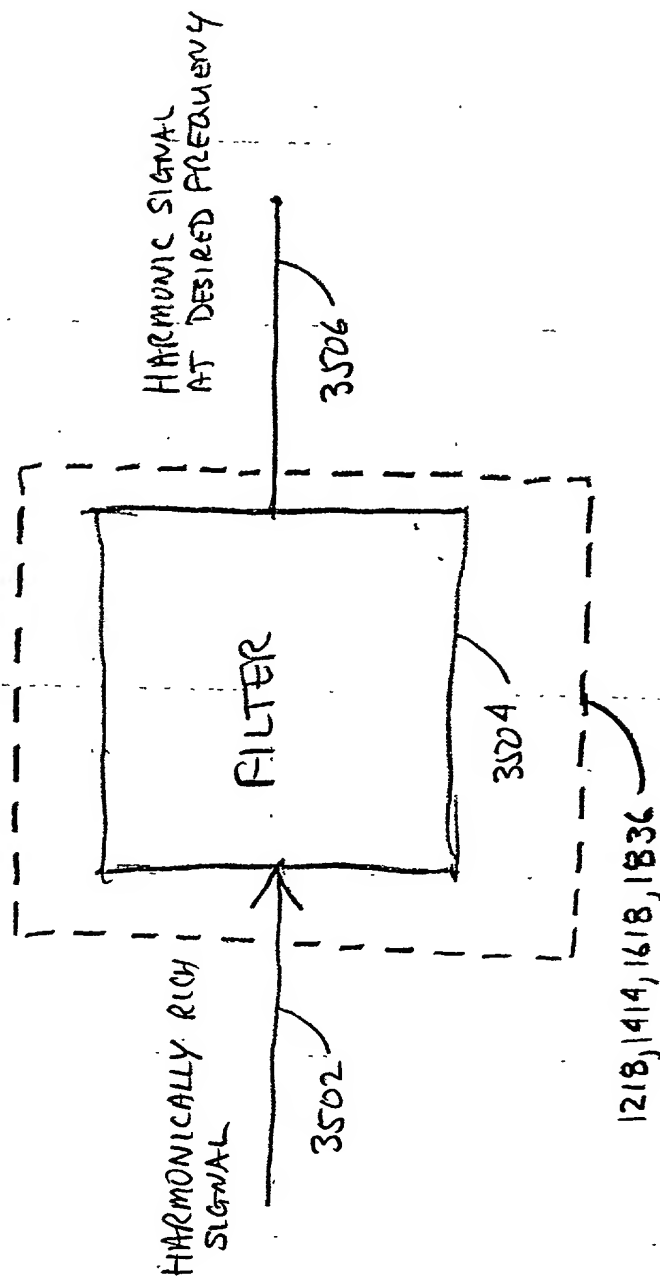


FIG. 35

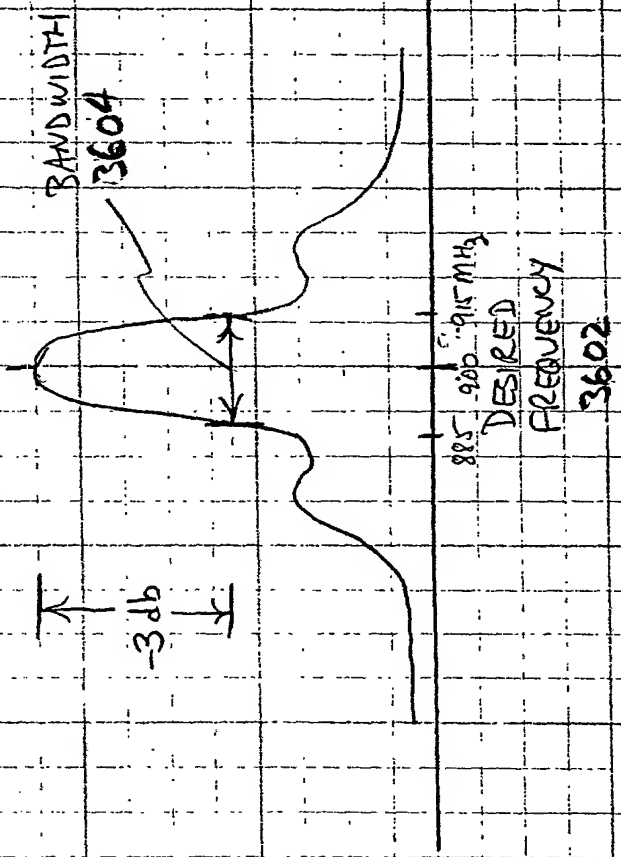


FIG 36

FIG. 37

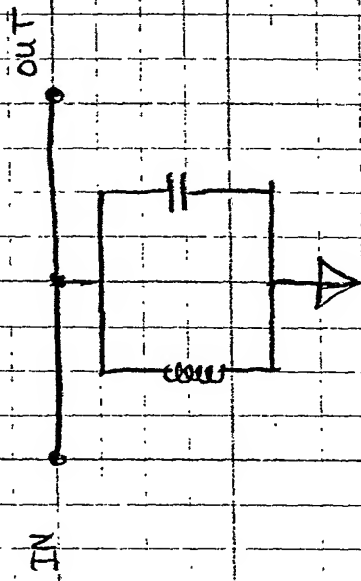


FIG. 37A

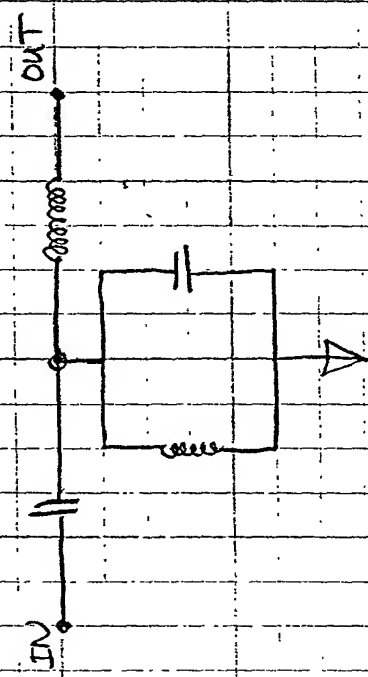


FIG. 37B

FIG. 37

13-782 500 SHEETS FULLER 8 SQUARE
 42-381 50 SHEETS EYE-GLASS 8 SQUARE
 42-382 100 SHEETS EYE-GLASS 8 SQUARE
 42-383 200 SHEETS EYE-GLASS 8 SQUARE
 42-384 500 SHEETS EYE-GLASS 8 SQUARE
 42-385 100 RECYCLED WHITE 8 SQUARE
 42-386 200 RECYCLED WHITE 8 SQUARE
 Made in U.S.A.

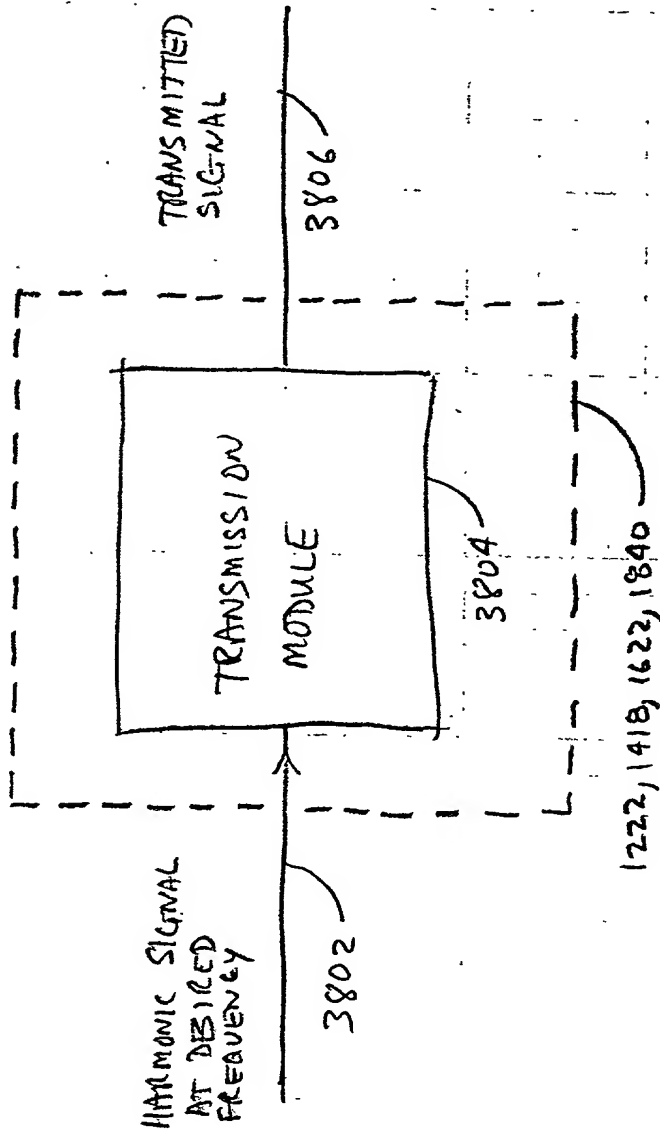


FIG. 380

FIG. 39A

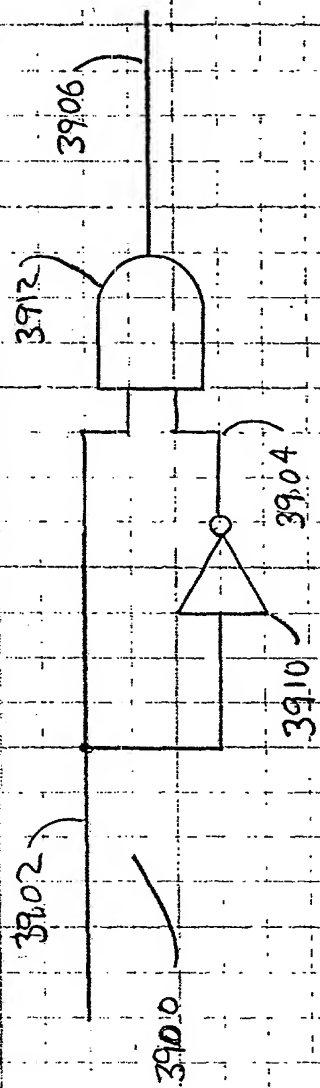
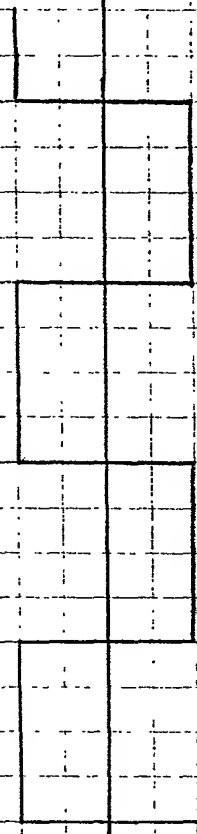


FIG. 39A

FIG. 39B

WAVEFORM
3902



WAVEFORM
3904

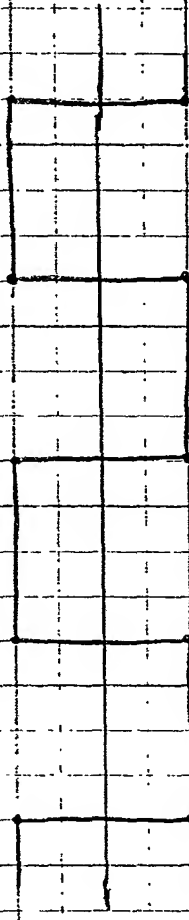


FIG. 39C

WAVEFORM
3906

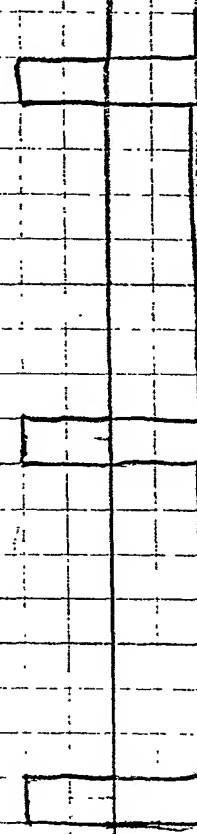


FIG. 39D

FIG. 39

m

WAVEFORM

FIG. 40A

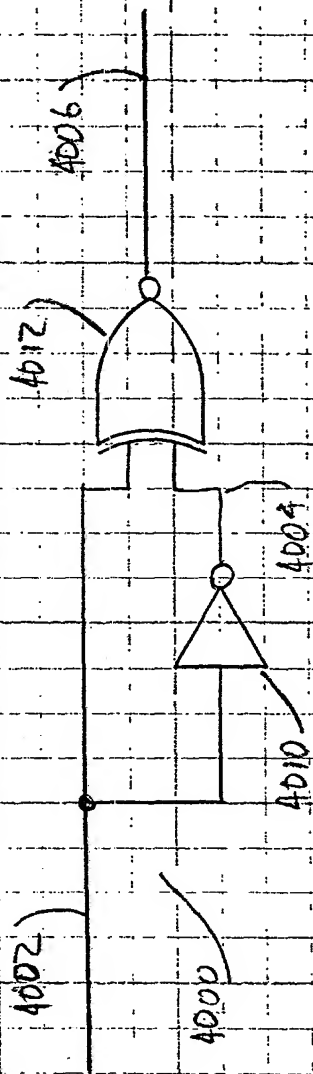
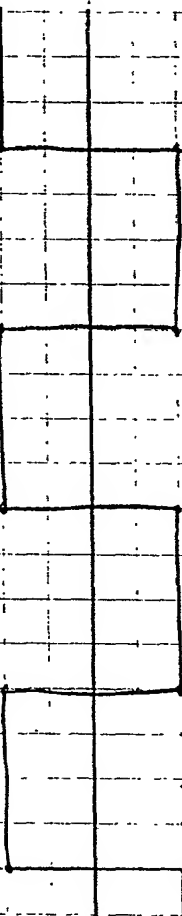
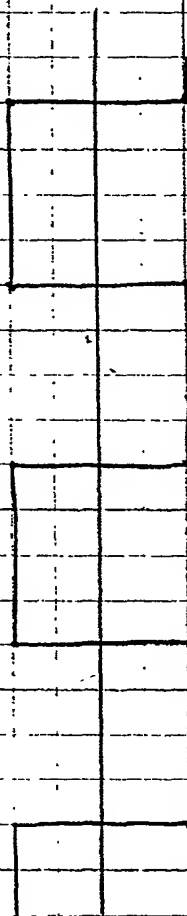


FIG. 40B



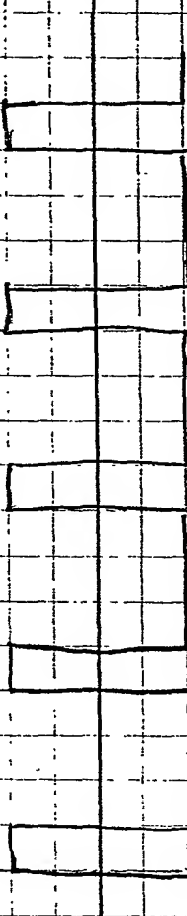
WAVEFORM
4002

FIG. 40C



WAVEFORM
4004

FIG. 40D



WAVEFORM
4006

FIG. 40

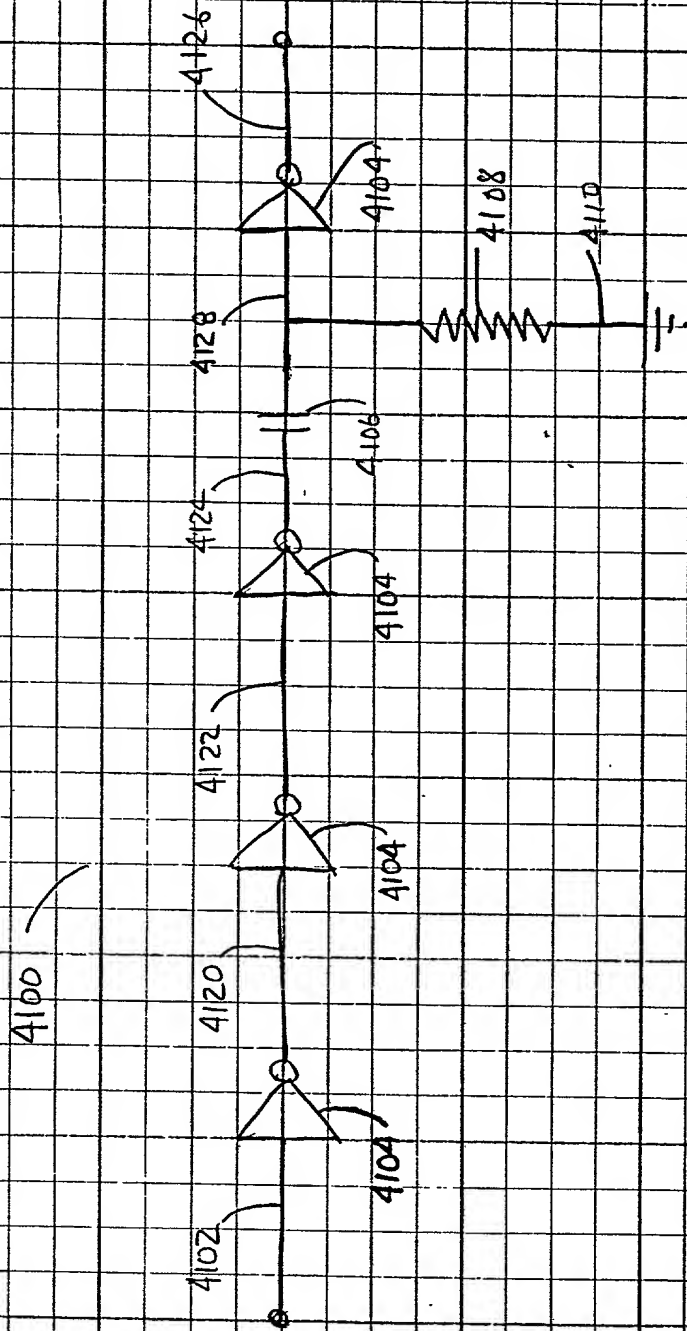


FIG. 41

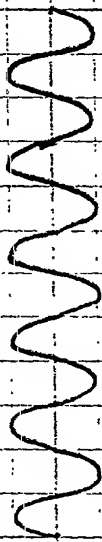


FIG. 42A

4102



FIG. 42B

4120

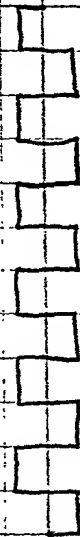


FIG. 42C

4124

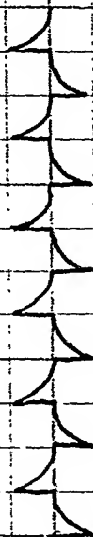


FIG. 42D

4128



FIG. 42E

4126

FIG. 42

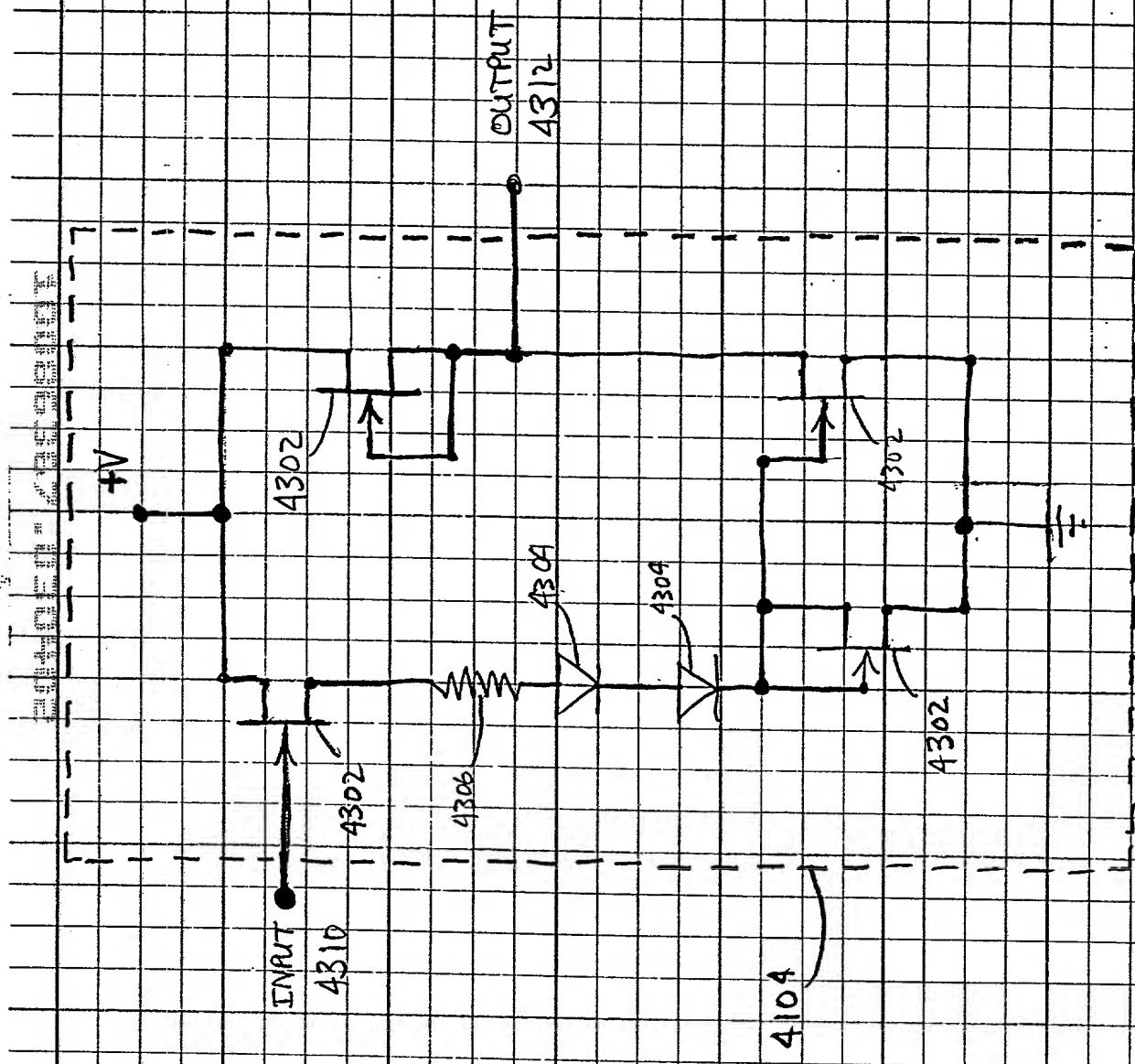


FIG. 43

INFORMATION

SIGNAL

4402

FIG. 44A

CARRIER SIGNAL

4404

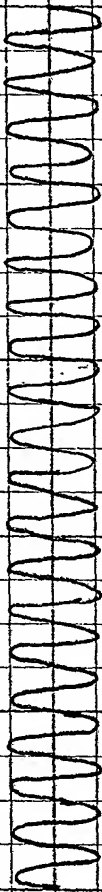


FIG. 44B

PM SIGNAL

4406

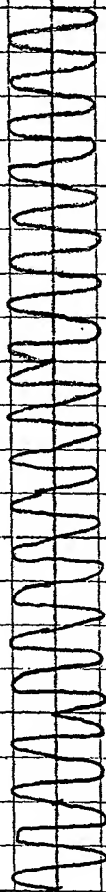


FIG. 44C

HARMONICALLY

RICH SIGNAL

4408

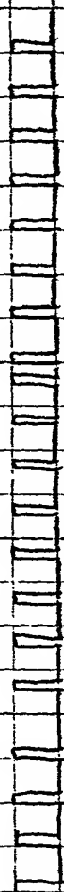


FIG. 44D

FUNDAMENTAL

HARMONIC 4410

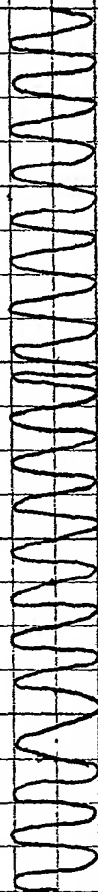


FIG. 44E

SECOND

HARMONIC 4412

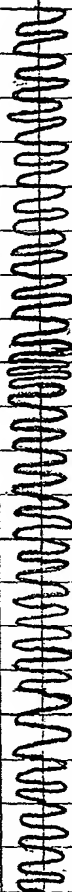


FIG. 44F

THIRD

HARMONIC 4414

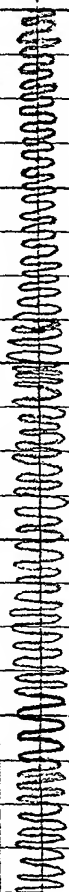


FIG. 44G

EXAMPLE WAVEFORMS IN A
PHASE MODULATION EMBODIMENT

FIG. 44

INFORMATION

SIGNAL

9502

CARRIER

SIGNAL

4504

HARMONICALLY

RICH SIGNAL

4506

FUNDAMENTAL

HARMONIC

4510

SECOND

HARMONIC

9512

THIRD

HARMONIC

9514

FIG. 45A

FIG. 45B

FIG. 45C

FIG. 45D

FIG. 45E

FIG. 45F

EXAMPLE WAVEFORMS IN AN
AMPLITUDE MODULATION EMBODIMENT

FIG. 45

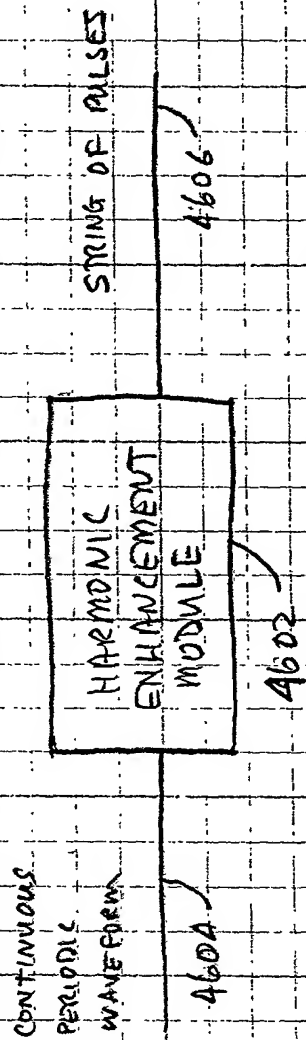


FIG. 46

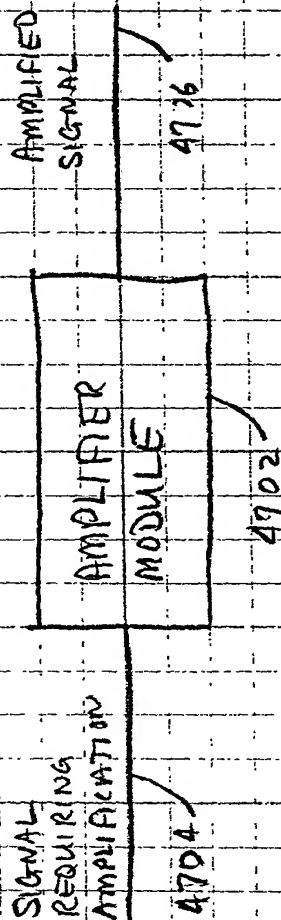


FIG. 47

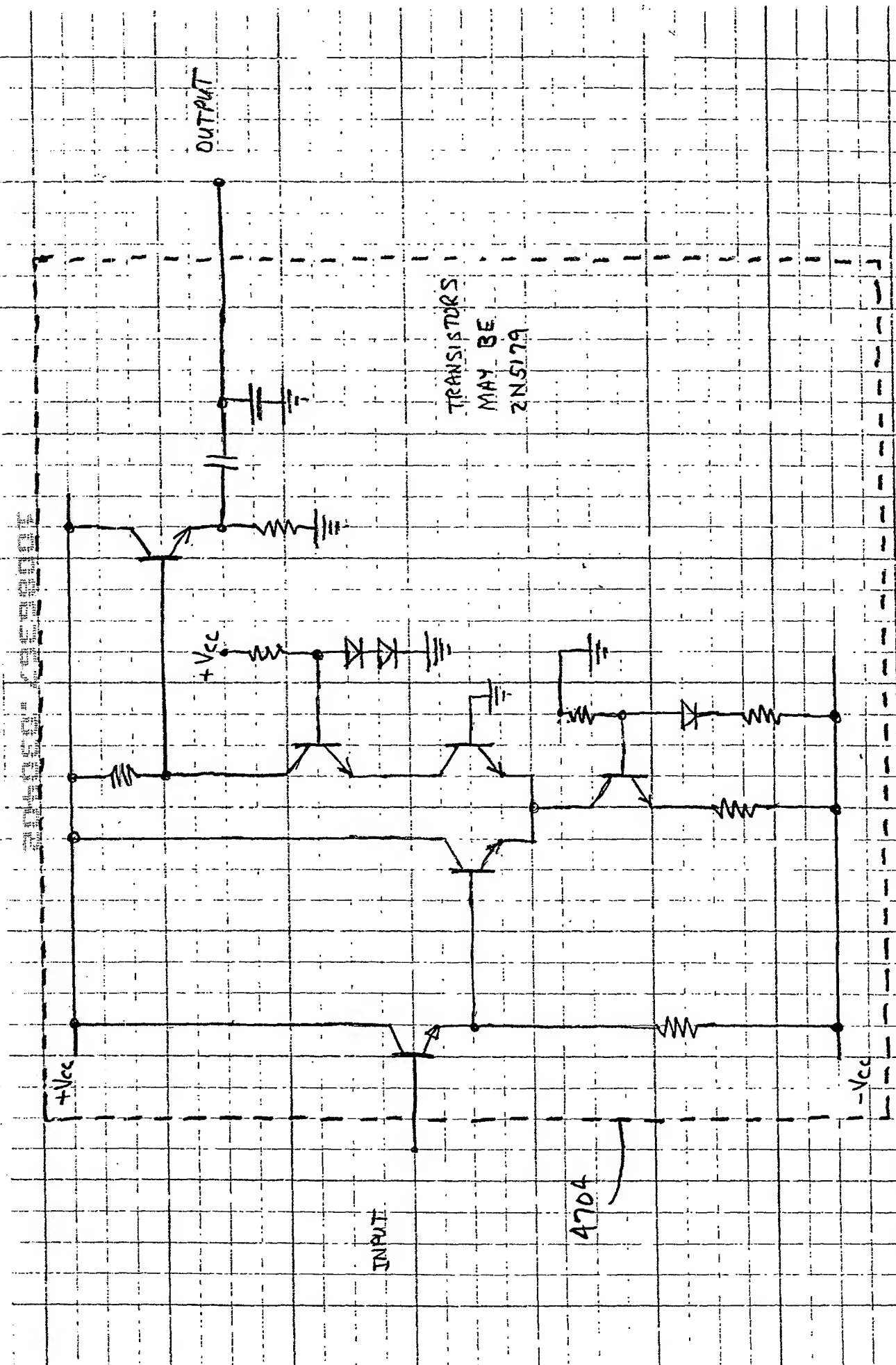


FIG. 48A

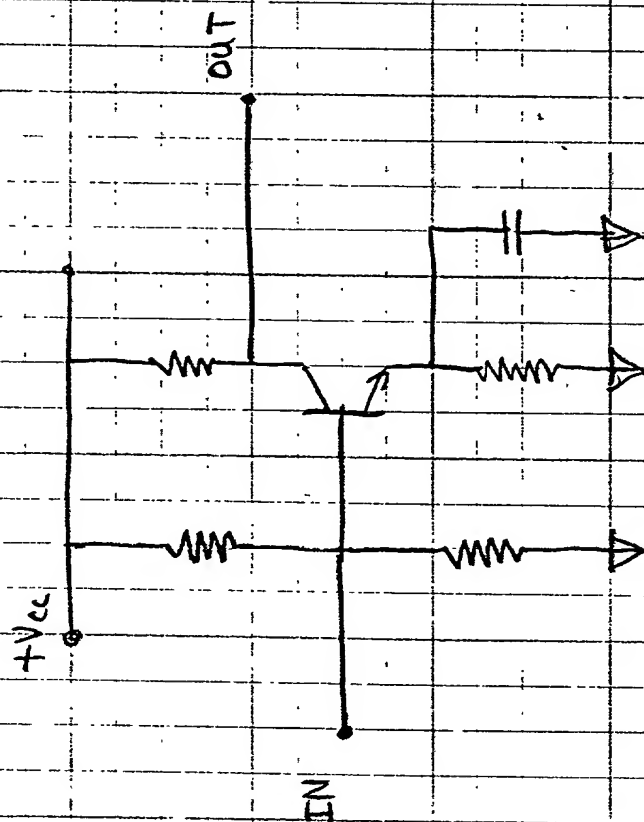


FIG. 48B

m

RECEIVED SIGNAL 4902

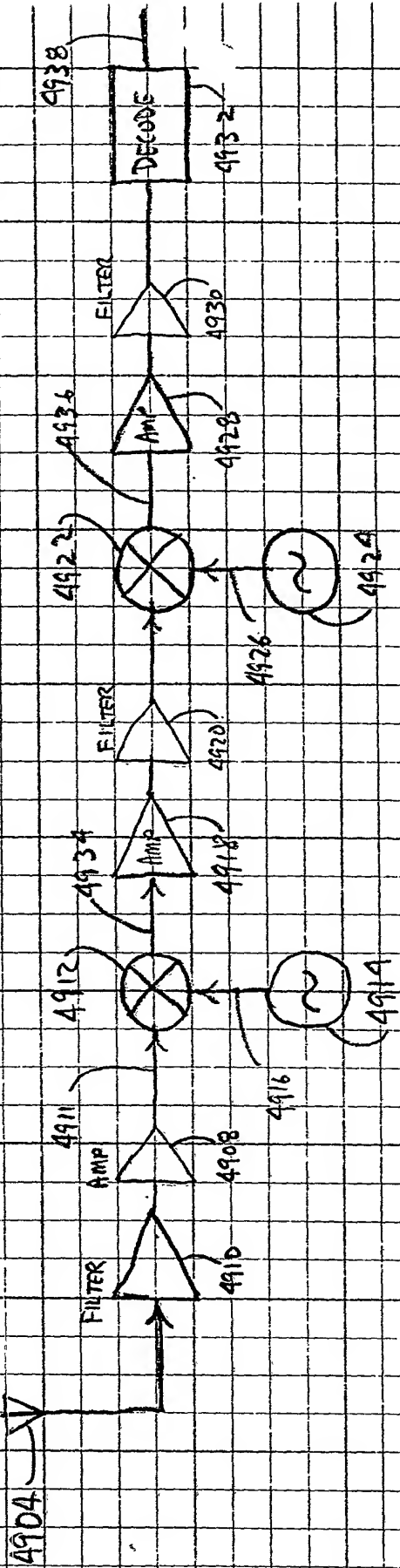
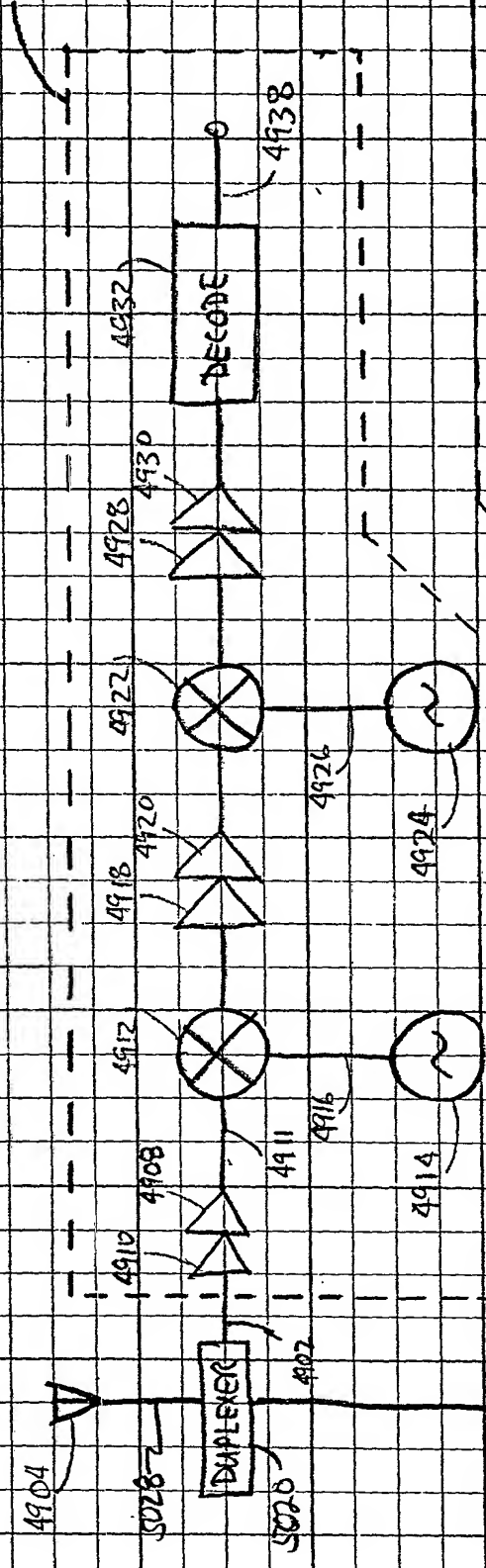


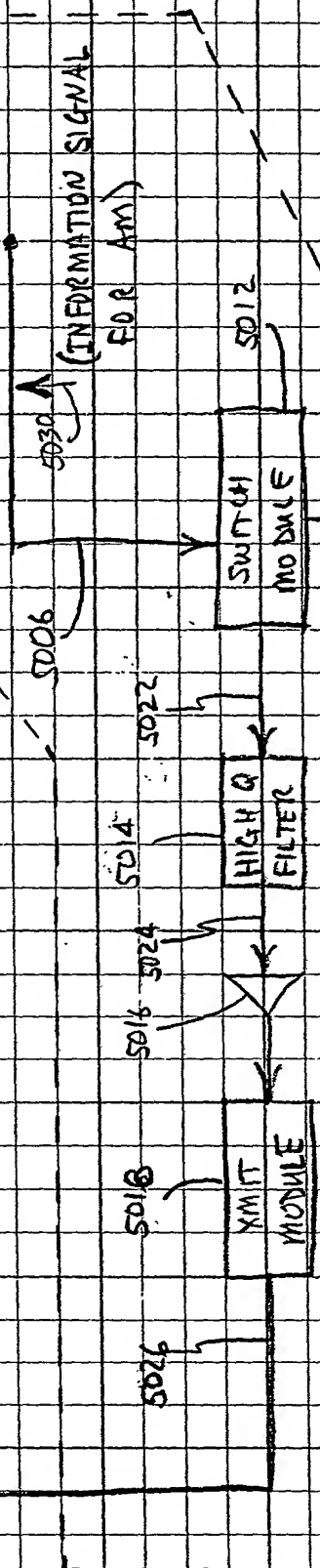
FIG. 49

RECEIVER

RECEIVER
MODULE
5001



BIAS/REFERENCE SIGNAL



TRANSMITTER
MODULE
5003

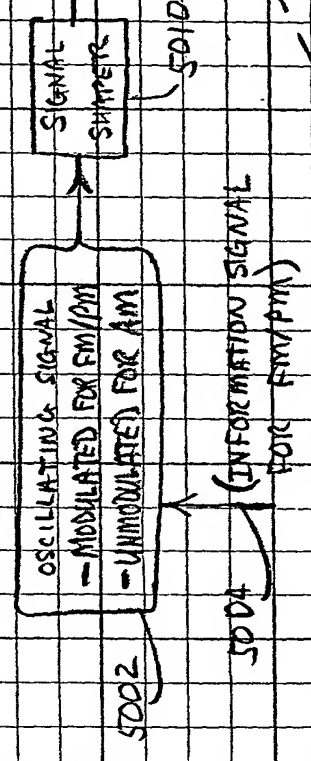


FIG. 50

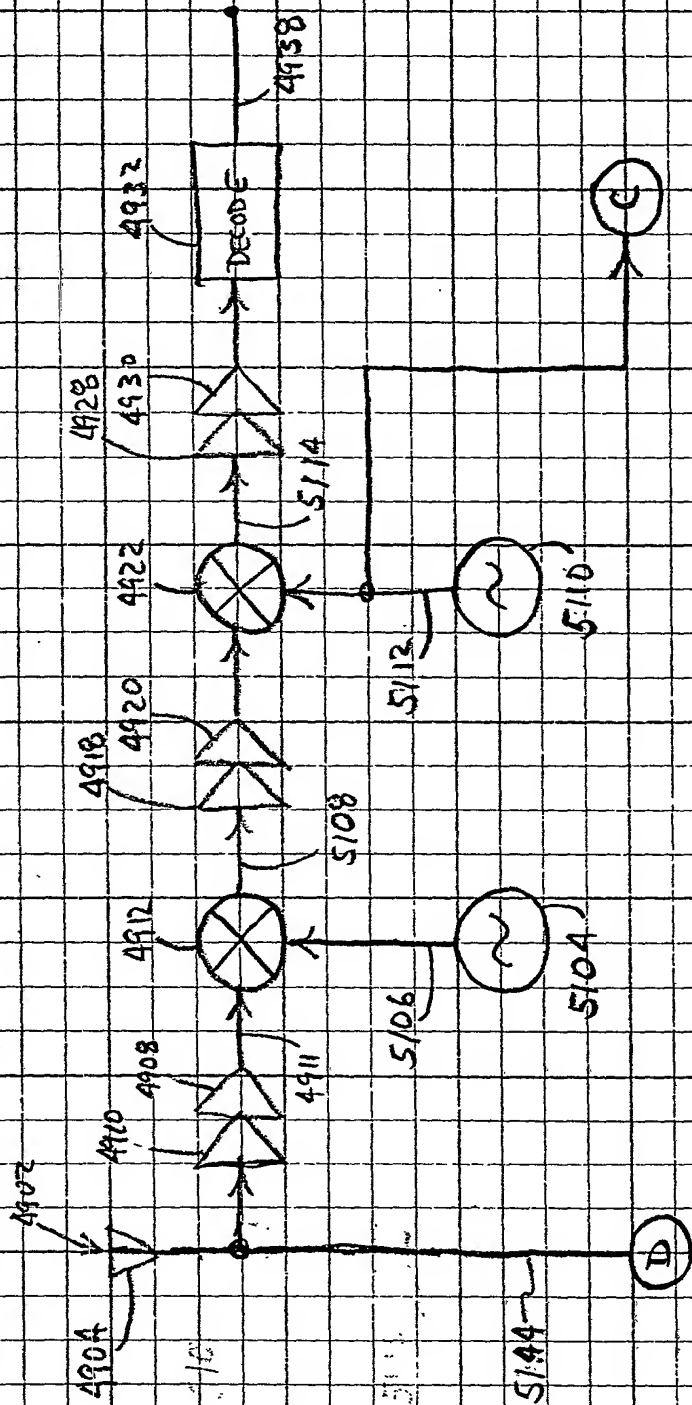
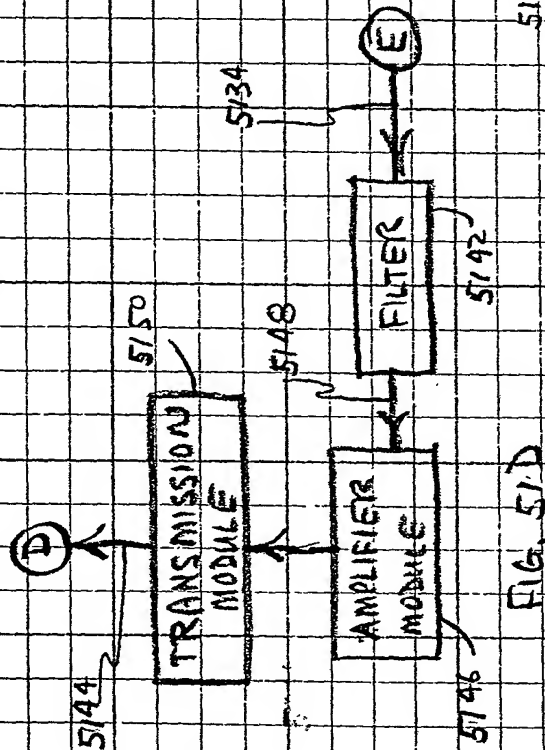
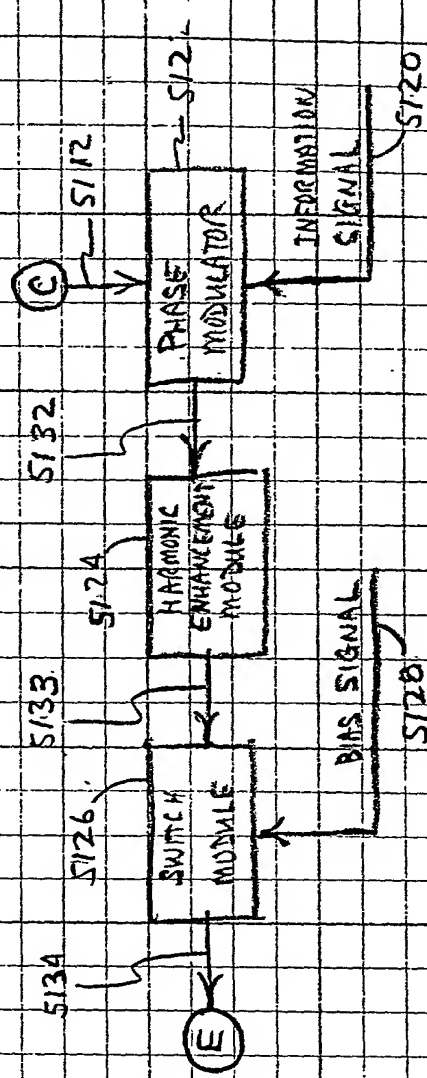
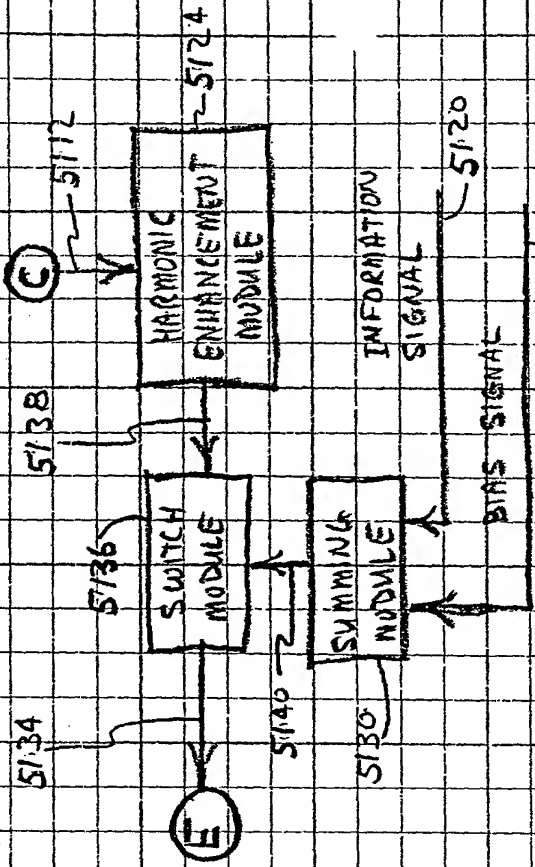
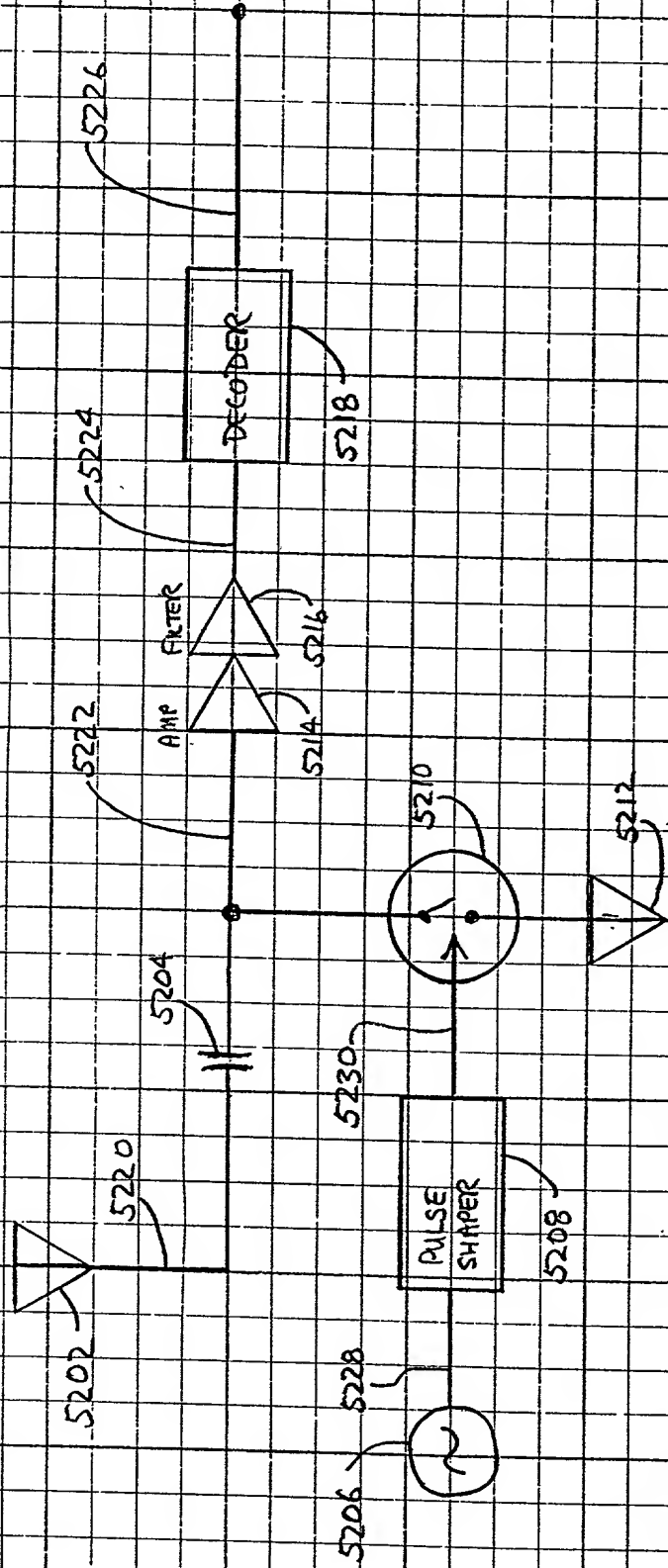


FIG. 51A



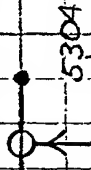


EXEMPLARY RECEIVER FOR
UNIVERSAL FREQUENCY DOWN-CONVERSION

FIG. 52

BIAS/REFERENCE
SIGNAL

5308

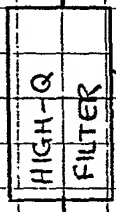


5304

INFORMATION
SIGNAL (AM)

5330

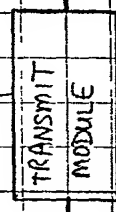
5320



5318

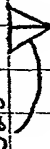
AMP

5322

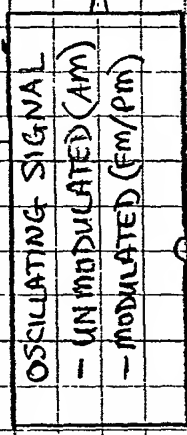


5324

5328



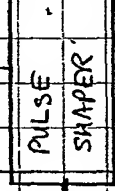
5326



5306

5302

INFORMATION
SIGNAL (FM/PM)



5310



5311

5312

5314



EXEMPLARY TRANSMITTER USING
THE PRESENT INVENTION

FIG. 53

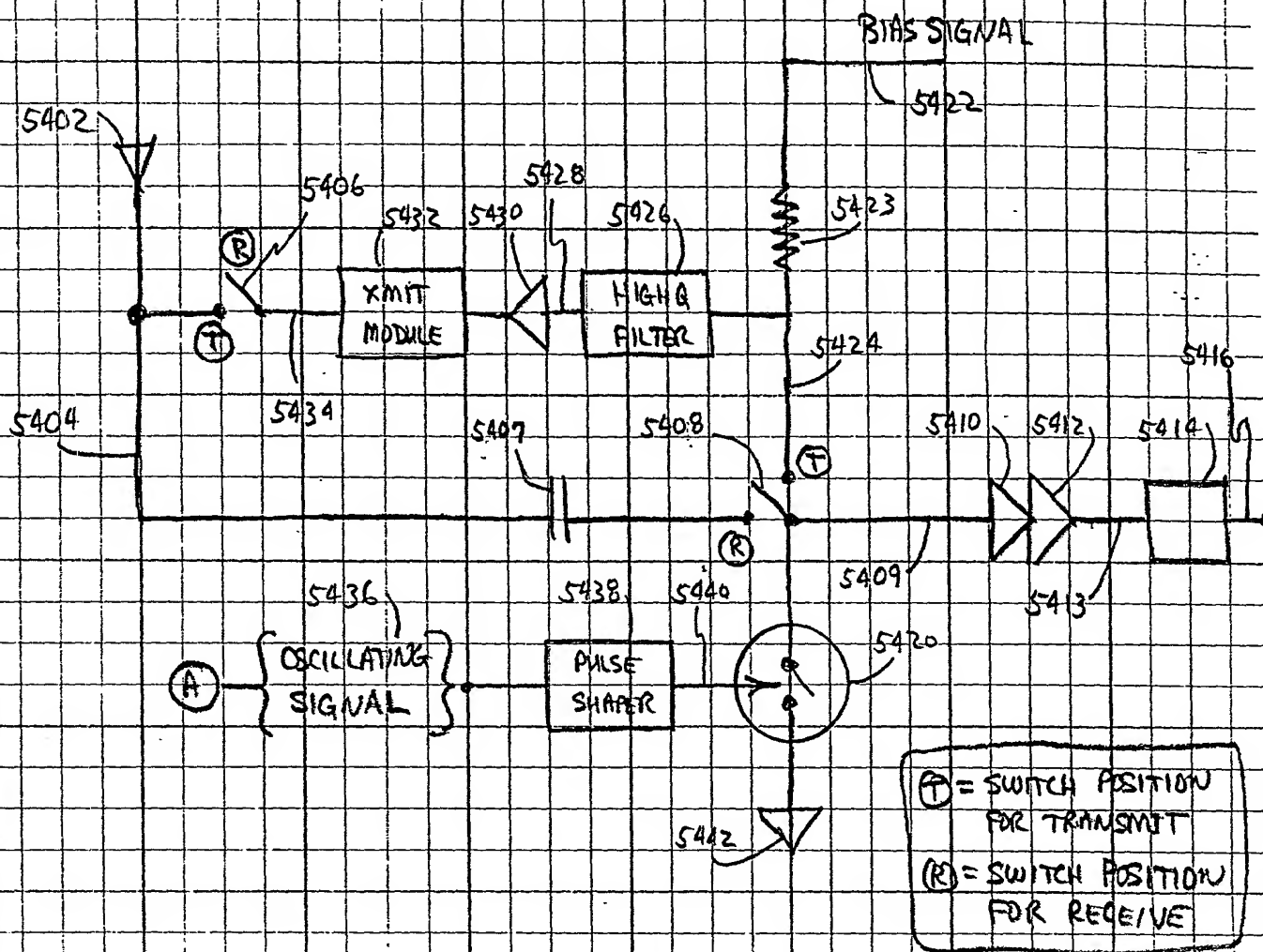
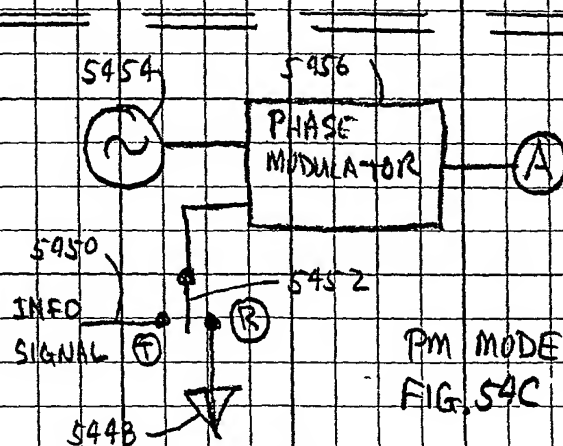
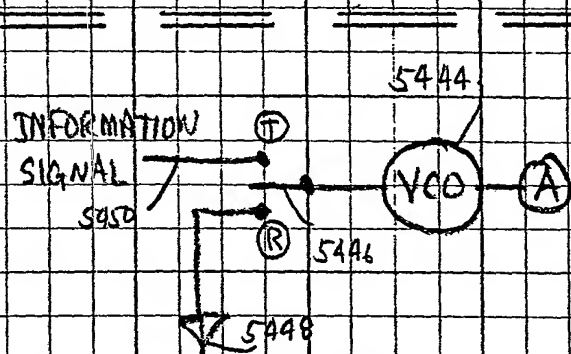


FIG. 54A - TRANSMITTER USING PRESENT INVENTION IN A HALF DUPLEX COMMUNICATIONS CIRCUIT WITH A UNIVERSAL FREQUENCY DOWN-CONVERTER (FM & PM)



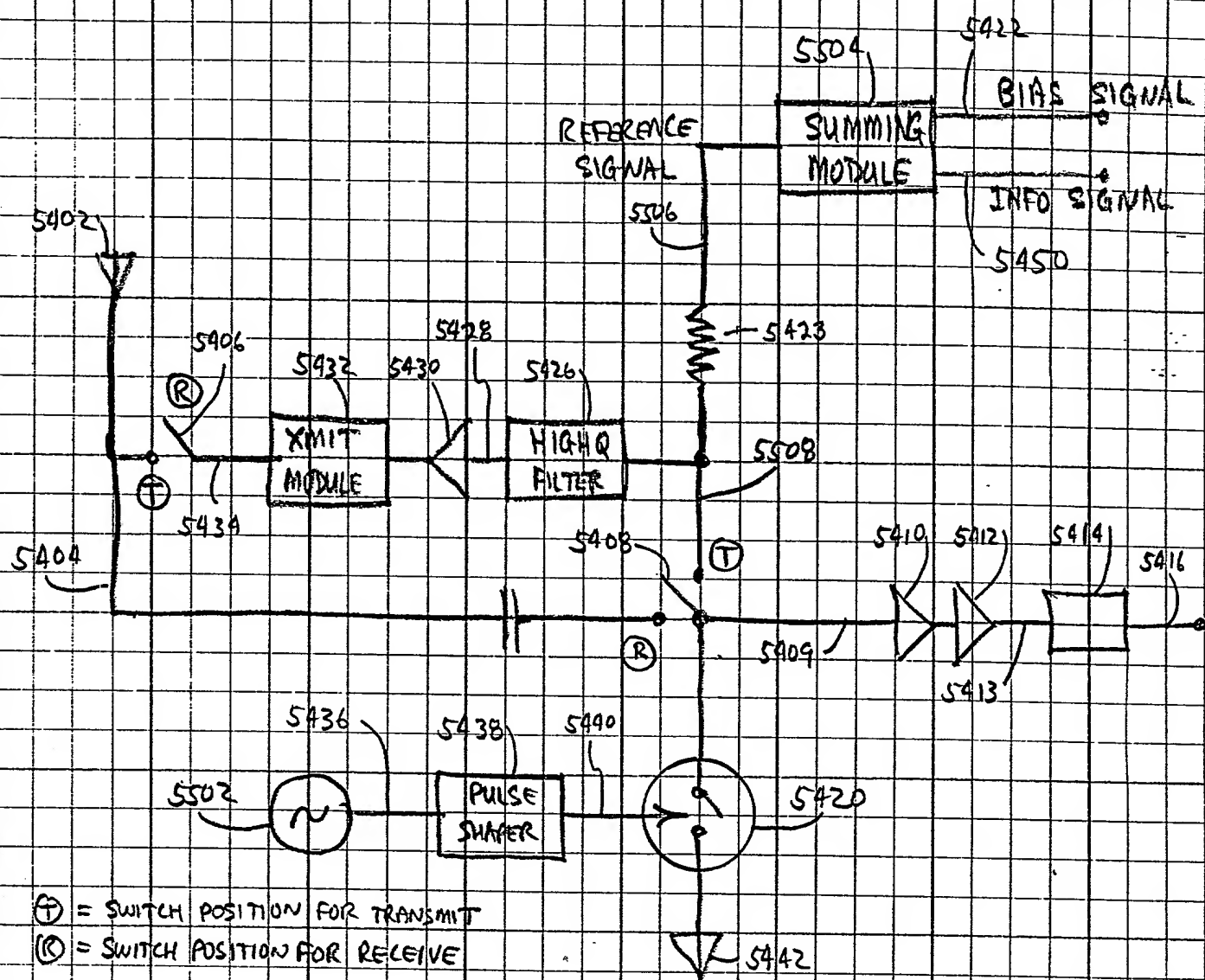


FIG. 55 - TRANSMITTER USING PRESENT INVENTION IN A HALF-DUPLEX COMMUNICATIONS CIRCUIT WITH A UNIVERSAL FREQUENCY DOWN-CONVERTER (AM)

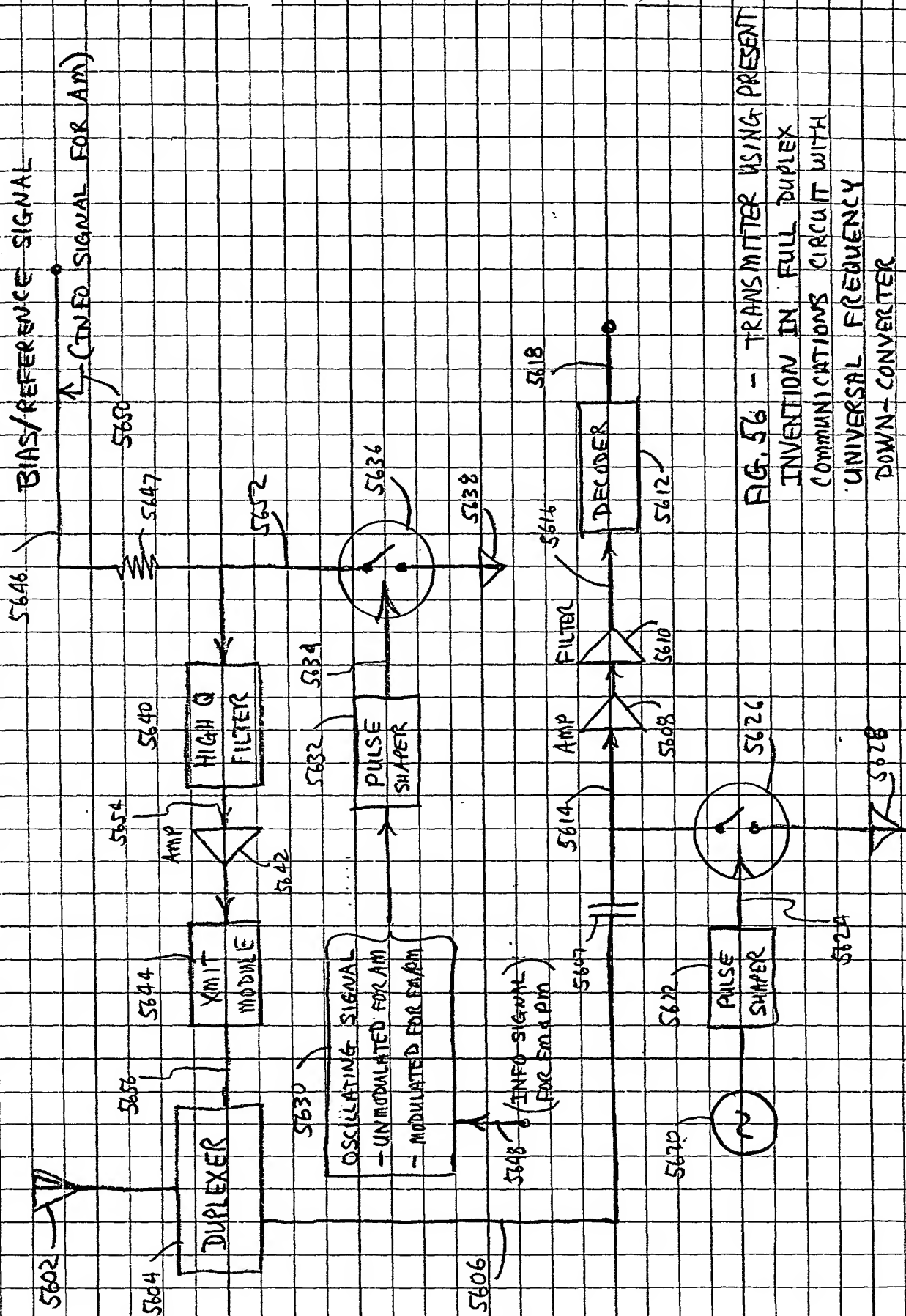
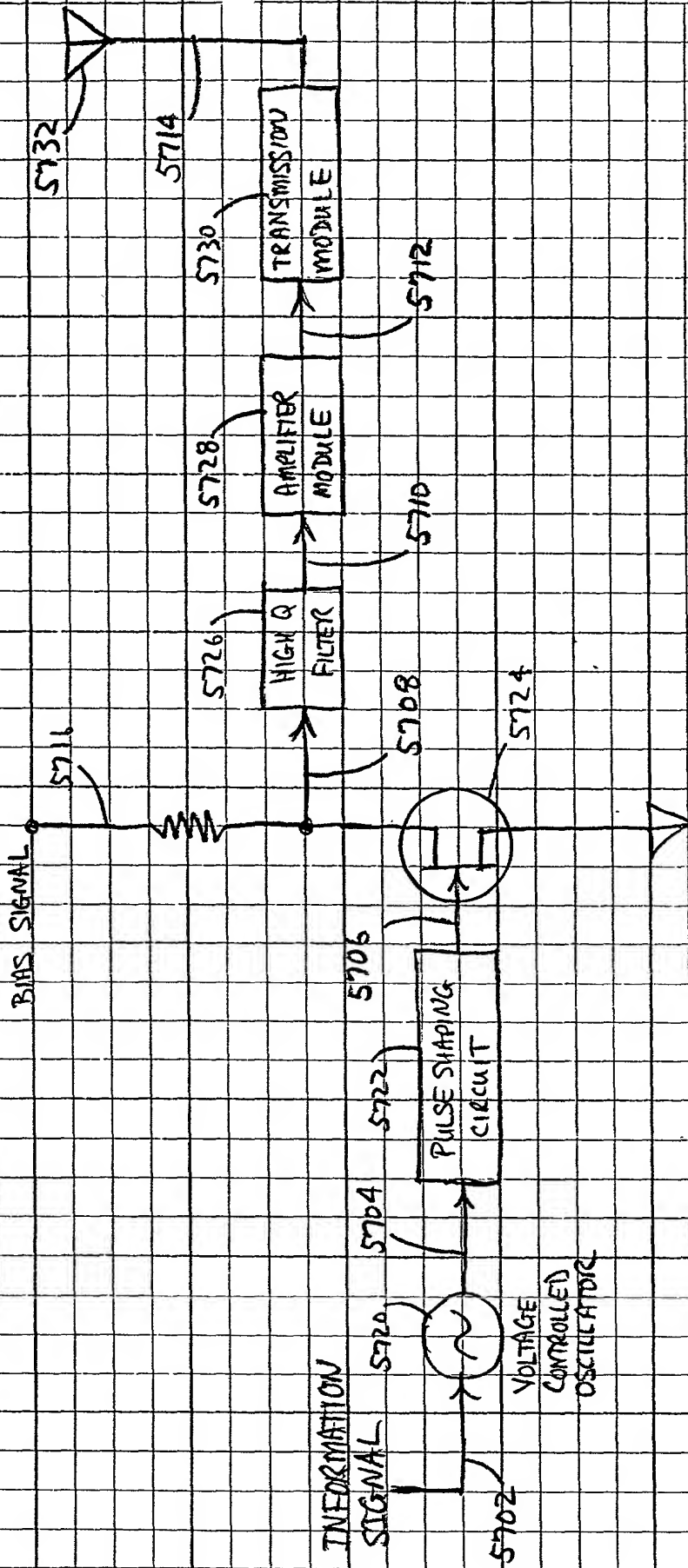
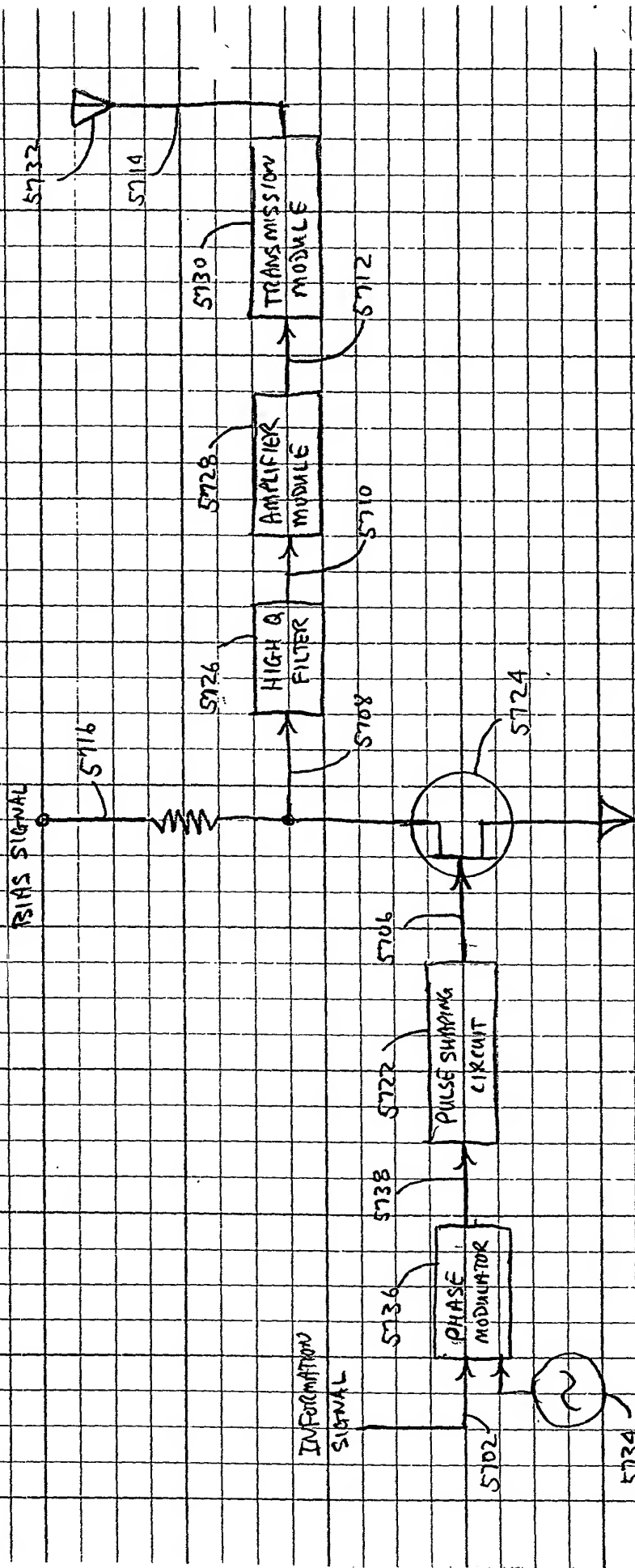


FIG. 56 - TRANSMITTER USING PRESENT INVENTION IN FULL DUPLEX COMMUNICATIONS CIRCUIT WITH UNIVERSAL FREQUENCY DOWN-CONVERTER



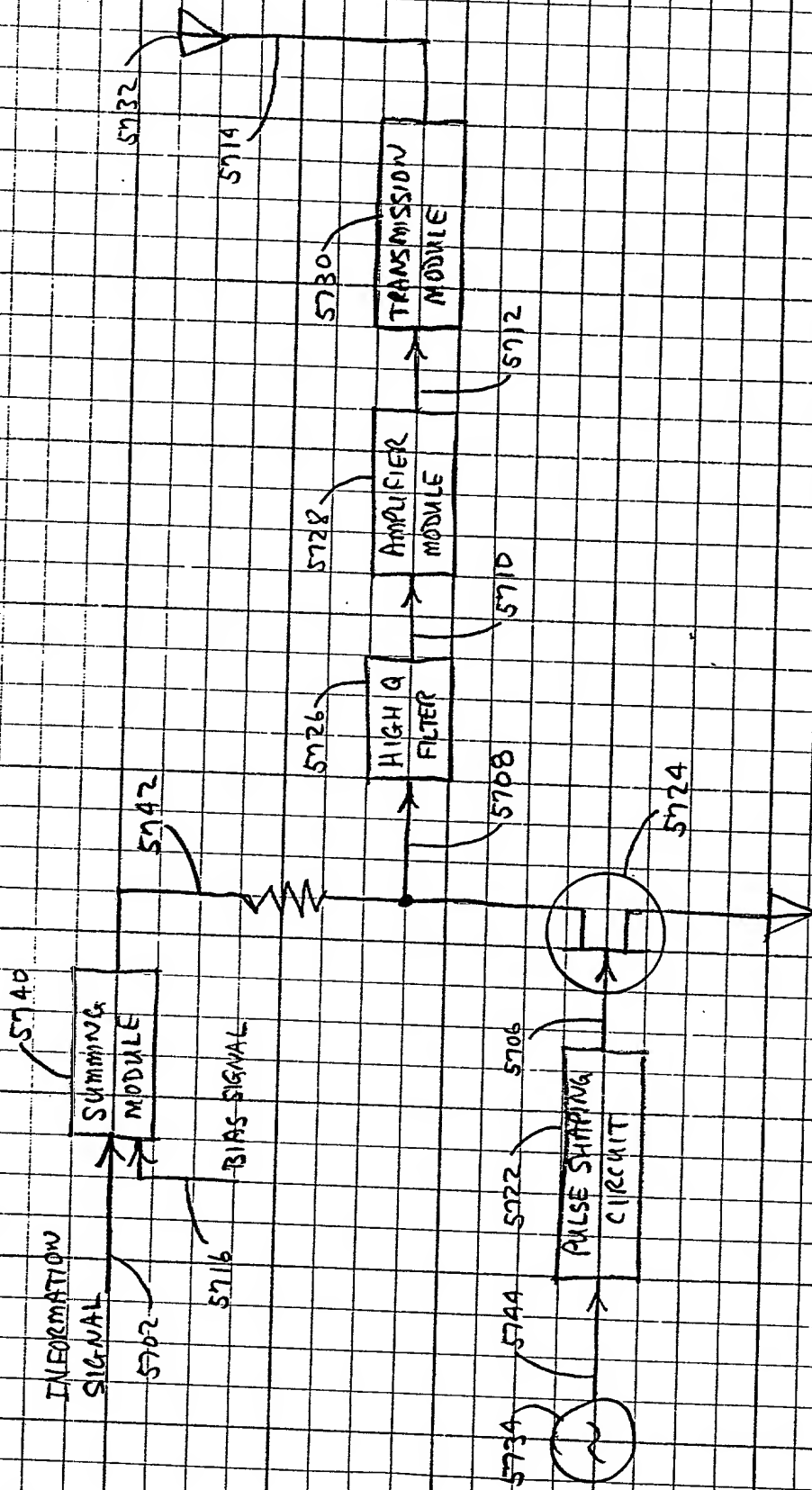
TRANSMITTER IN THE PM EMBODIMENT

FIG. 57A



TRANSMITTER IN THE AM EMBODIMENT

FIG. 57B



TRANSMITTER IN THE AM EMBODIMENT

FIG. 57C

204000 299900

PW/T ratio = 0.1

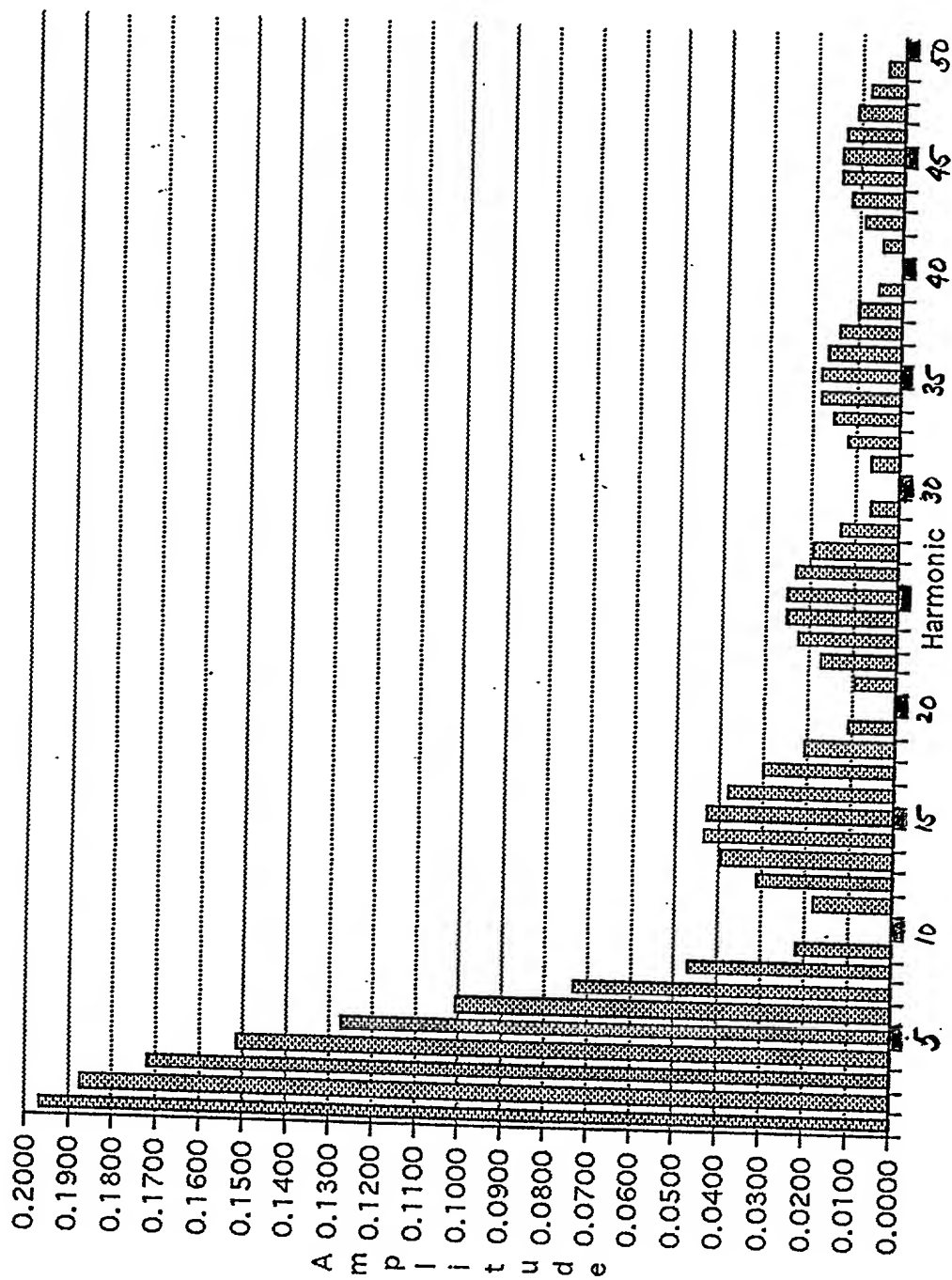


FIG. 58

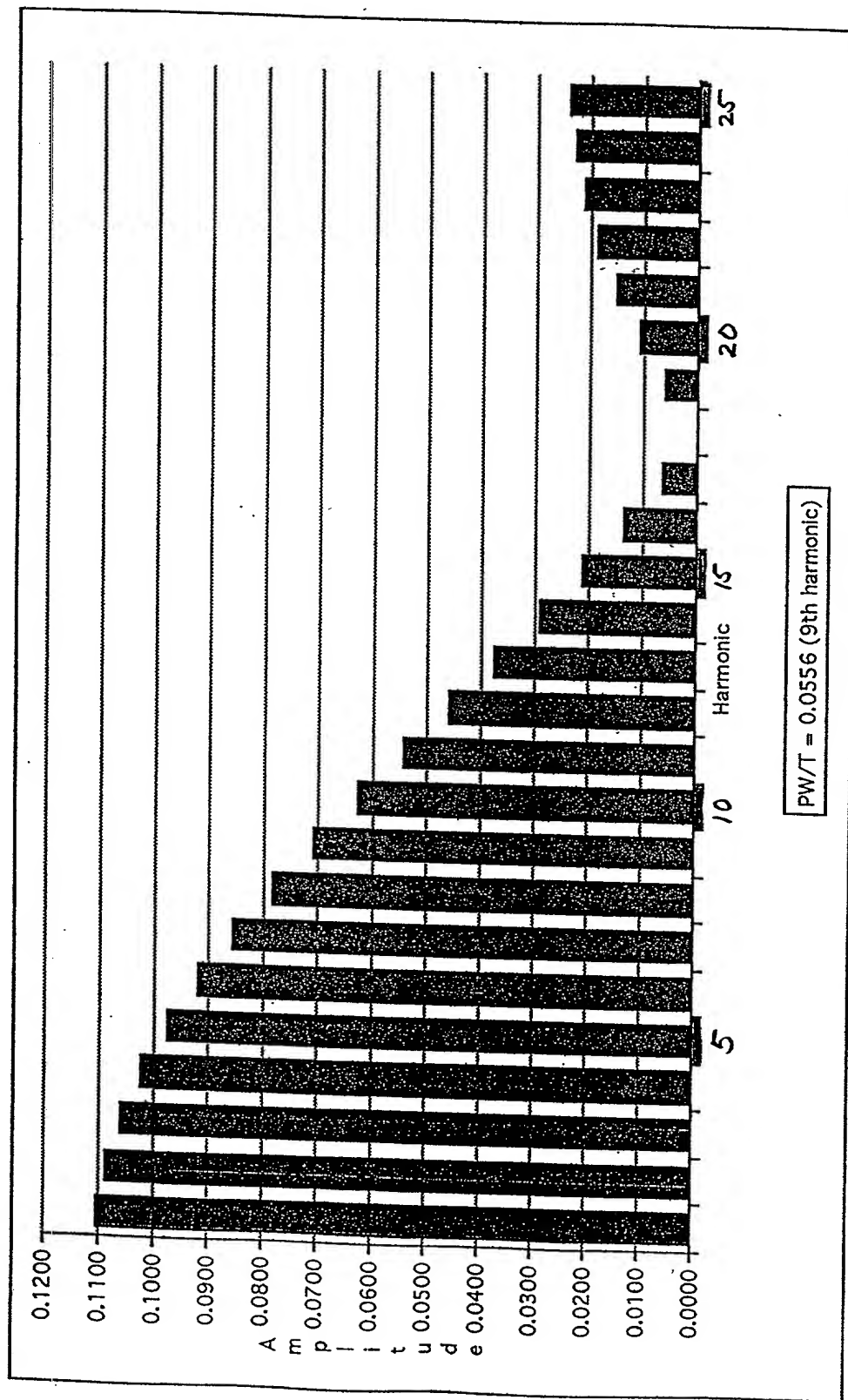


FIG. 59

Harmonic	τ/T	ω	0	0.250	0.100	0.050	0.010	0.005
1			0.6366	0.4502	0.1967	0.0996	0.0200	0.01000
2			0.00	0.3183	0.1871	0.0984	0.0200	0.01000
3			0.2122	0.1501	0.1717	0.0963	0.0200	0.01000
4			0.00	0.00	0.1514	0.0935	0.0199	0.00999
5			0.1273	0.0900	0.1273	0.0900	0.0199	0.00999
6			0.00	0.1061	0.1009	0.0858	0.0199	0.00999
7			0.0909	0.0643	0.0736	0.0810	0.0198	0.00998
8			0.00	0.00	0.0468	0.0757	0.0198	0.00997
9			0.0707	0.0500	0.0219	0.0699	0.0197	0.00997
10			0.00	0.0637	0.00	0.0637	0.0197	0.00996
11			0.0579	0.0409	0.0179	0.0572	0.0196	0.00995
12			0.00	0.00	0.0312	0.0505	0.0195	0.00994
13			0.0490	0.0346	0.0396	0.0436	0.0194	0.00993
14			0.00	0.0455	0.0432	0.0368	0.0194	0.00992
15			0.0424	0.0300	0.0424	0.0300	0.0193	0.00991
16			0.00	0.00	0.0378	0.0234	0.0192	0.00990
17			0.0374	0.0265	0.0303	0.0170	0.0191	0.00988
18			0.00	0.0354	0.0208	0.0109	0.0190	0.00987
19			0.0335	0.0237	0.0104	0.0052	0.0188	0.00985
20			0.00	0.00	0.00	0.00	0.0187	0.00984
21			0.0303	0.0214	0.0094	0.0047	0.0186	0.00982
22			0.00	0.0289	0.0170	0.0089	0.0184	0.00980
23			0.0277	0.0196	0.0224	0.0126	0.0183	0.00978
24			0.00	0.00	0.0252	0.0156	0.0182	0.00976
25			0.0255	0.0180	0.0255	0.0180	0.0180	0.00974
26			0.00	0.0245	0.0233	0.0198	0.0178	0.00972
27			0.0236	0.0167	0.0191	0.0210	0.0177	0.00970
28			0.00	0.00	0.0134	0.0216	0.0175	0.00968
29			0.0220	0.0155	0.0068	0.0217	0.0173	0.00966
30			0.00	0.0212	0.00	0.0212	0.0172	0.00963
31			0.0205	0.0145	0.0063	0.0203	0.0170	0.00961
32			0.00	0.00	0.0117	0.0189	0.0168	0.00958
33			0.0193	0.0136	0.0156	0.0172	0.0166	0.00956
34			0.00	0.0187	0.0178	0.0151	0.0164	0.00953
35			0.0182	0.0129	0.0182	0.0129	0.0162	0.00950
36			0.00	0.00	0.0168	0.0104	0.0160	0.00948
37			0.0172	0.0122	0.0139	0.0078	0.0158	0.00945
38			0.00	0.0168	0.0098	0.0052	0.0156	0.00942
39			0.0163	0.0115	0.0050	0.0026	0.0154	0.00939
40			0.00	0.00	0.00	0.00	0.0151	0.00935
41			0.0155	0.0110	0.0048	0.0024	0.0149	0.00932
42			0.00	0.0152	0.0089	0.0047	0.0147	0.00929
43			0.0148	0.0105	0.0120	0.0067	0.0144	0.00926
44			0.00	0.00	0.0138	0.0085	0.0142	0.00922
45			0.0141	0.0100	0.0141	0.0100	0.0140	0.00919
46			0.00	0.0138	0.0132	0.0112	0.0137	0.00915
47			0.0135	0.0096	0.0110	0.0121	0.0135	0.00912
48			0.00	0.00	0.0078	0.0126	0.0132	0.00908
49			0.0130	0.0092	0.0040	0.0128	0.0130	0.00904
50			0.00	0.0127	0.00	0.0127	0.0127	0.00900

6000
↙

FIG. 60

m

TABLE C-3000

6100 →

Harmonic	π/T	0.5000	0.2500	0.1667	0.1250	0.1000	0.0833	0.0714	0.0625	0.0556	0.0500
1		0.6366	0.4502	0.3183	0.2436	0.1967	0.1648	0.1417	0.1242	0.1105	0.0996
2		0.0000	0.3183	0.2757	0.2251	0.1871	0.1592	0.1381	0.1218	0.1089	0.0984
3		0.2122	0.1501	0.2122	0.1961	0.1717	0.1501	0.1323	0.1179	0.1061	0.0963
4		0.0000	0.0000	0.1378	0.1592	0.1514	0.1378	0.1244	0.1125	0.1023	0.0935
5		0.1273	0.0900	0.0637	0.1176	0.1273	0.1230	0.1147	0.1059	0.0975	0.0900
6		0.0000	0.1061	0.0000	0.0750	0.1009	0.1061	0.1034	0.0980	0.0919	0.0858
7		0.0909	0.0643	0.0455	0.0348	0.0736	0.0878	0.0909	0.0892	0.0855	0.0810
8		0.0000	0.0000	0.0689	0.0000	0.0468	0.0689	0.0776	0.0796	0.0784	0.0757
9		0.0707	0.0500	0.0707	0.0271	0.0219	0.0500	0.0637	0.0694	0.0707	0.0699
10		0.0000	0.0637	0.0551	0.0450	0.0000	0.0318	0.0498	0.0588	0.0627	0.0637
11		0.0579	0.0409	0.0289	0.0535	0.0179	0.0150	0.0361	0.0481	0.0544	0.0572
12		0.0000	0.0000	0.0000	0.0531	0.0312	0.0000	0.0230	0.0375	0.0459	0.0505
13		0.0490	0.0346	0.0245	0.0452	0.0396	0.0127	0.0109	0.0272	0.0375	0.0436
14		0.0000	0.0455	0.0394	0.0322	0.0432	0.0227	0.0000	0.0174	0.0292	0.0368
15		0.0424	0.0300	0.0424	0.0162	0.0424	0.0300	0.0094	0.0083	0.0212	0.0300
16		0.0000	0.0000	0.0345	0.0000	0.0378	0.0345	0.0173	0.0000	0.0136	0.0234
17		0.0374	0.0265	0.0187	0.0143	0.0303	0.0362	0.0233	0.0073	0.0065	0.0170
18		0.0000	0.0354	0.0000	0.0250	0.0208	0.0354	0.0277	0.0135	0.0000	0.0109
19		0.0335	0.0237	0.0168	0.0310	0.0104	0.0324	0.0302	0.0186	0.0058	0.0052
20		0.0000	0.0000	0.0276	0.0318	0.0000	0.0276	0.0310	0.0225	0.0109	0.0000
21		0.0303	0.0214	0.0303	0.0280	0.0094	0.0214	0.0303	0.0252	0.0152	0.0047
22		0.0000	0.0289	0.0251	0.0205	0.0170	0.0145	0.0282	0.0267	0.0186	0.0089
23		0.0277	0.0196	0.0138	0.0106	0.0224	0.0072	0.0249	0.0271	0.0212	0.0126
24		0.0000	0.0000	0.0000	0.0000	0.0252	0.0000	0.0207	0.0265	0.0230	0.0156
25		0.0255	0.0180	0.0127	0.0097	0.0255	0.0066	0.0159	0.0250	0.0239	0.0180

FIG. 61

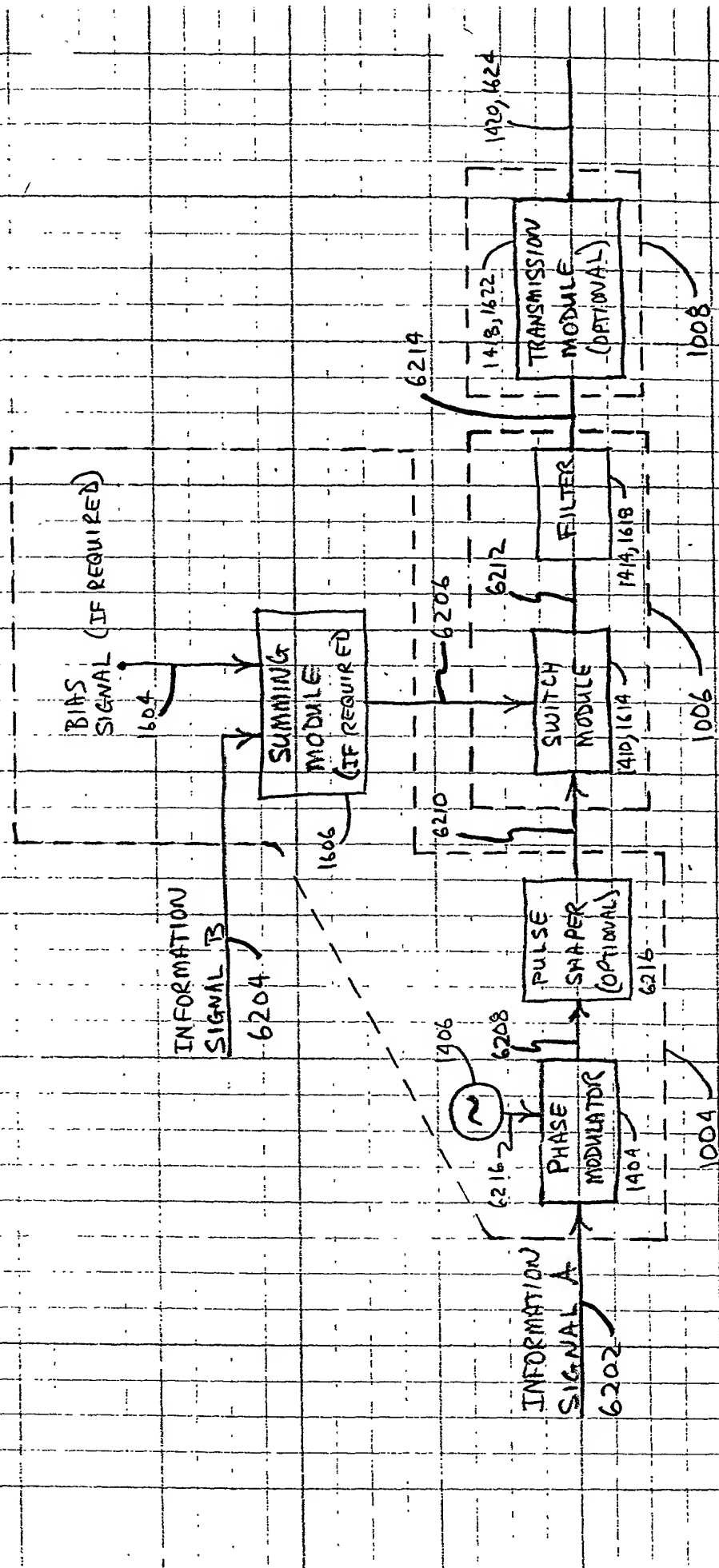


FIG. 62

INFORMATION
SIGNAL A
6204

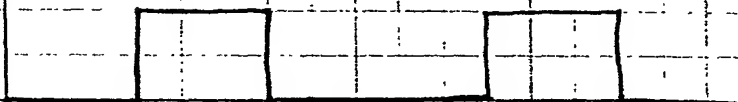


FIG. 63A

OSCILLATING
SIGNAL
6216

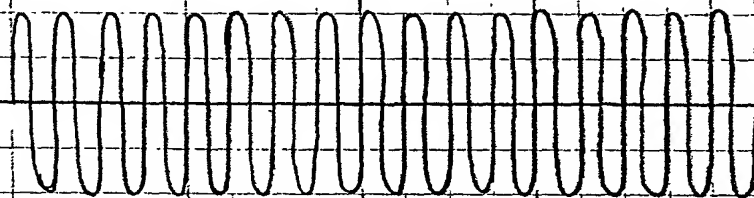


FIG. 63B

PHASE
MODULATED
SIGNAL
6208

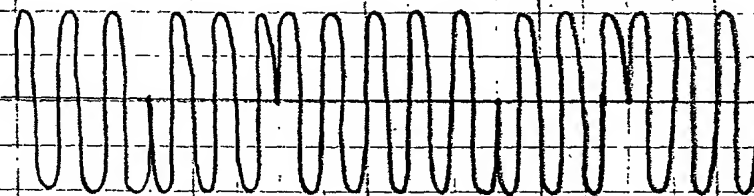


FIG. 63C

PULSE-SHAPED
PM SIGNAL
6210



FIG. 63D

FIG. 63

REFERENCE
SIGNAL
6206

+V

0

FIG. 63 E

HARMONICALLY
RICH SIGNAL
6212

FIG. 63 F

FUNDAMENTAL
HARMONIC OF
SIGNAL 6212

FIG. 63 G

SECOND HARMONIC
OF SIGNAL 6212

FIG. 63 H

FIG. 63 (continued)

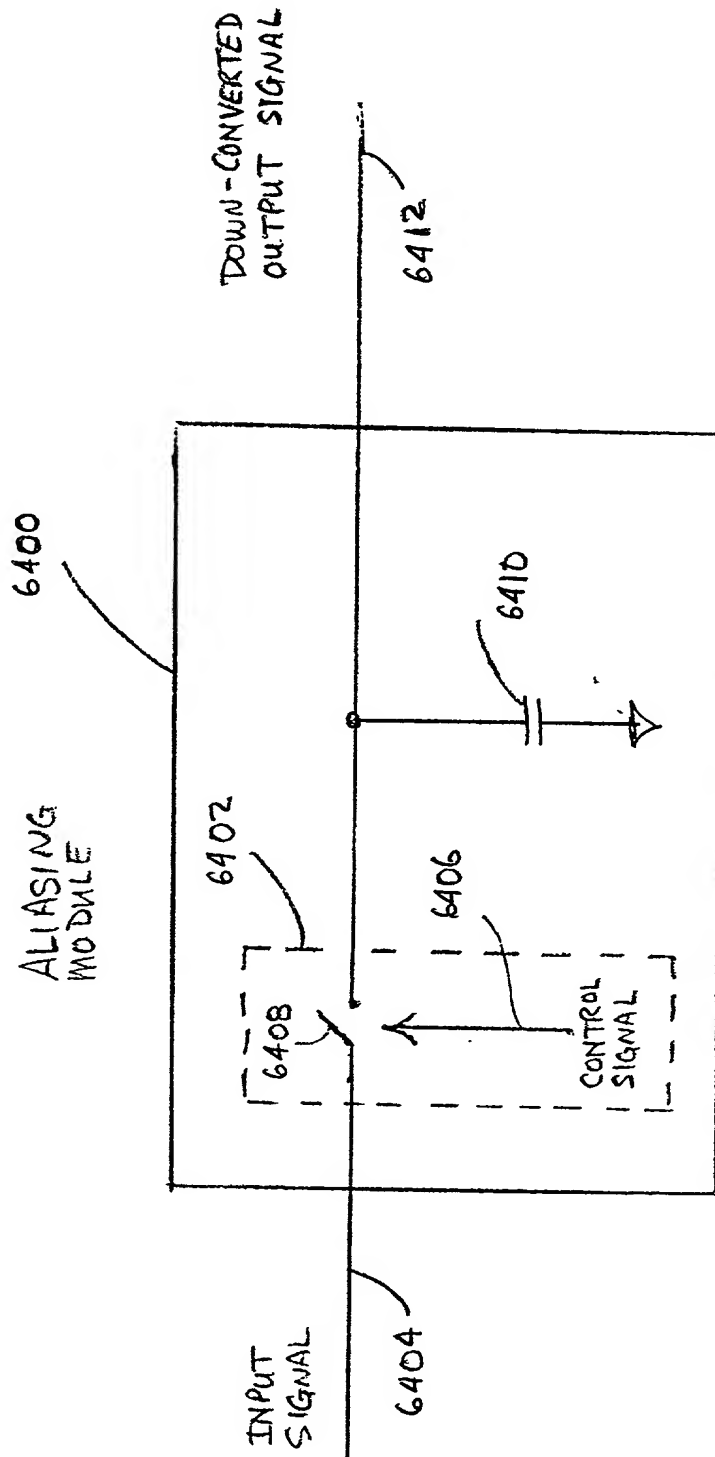


FIG. 64A

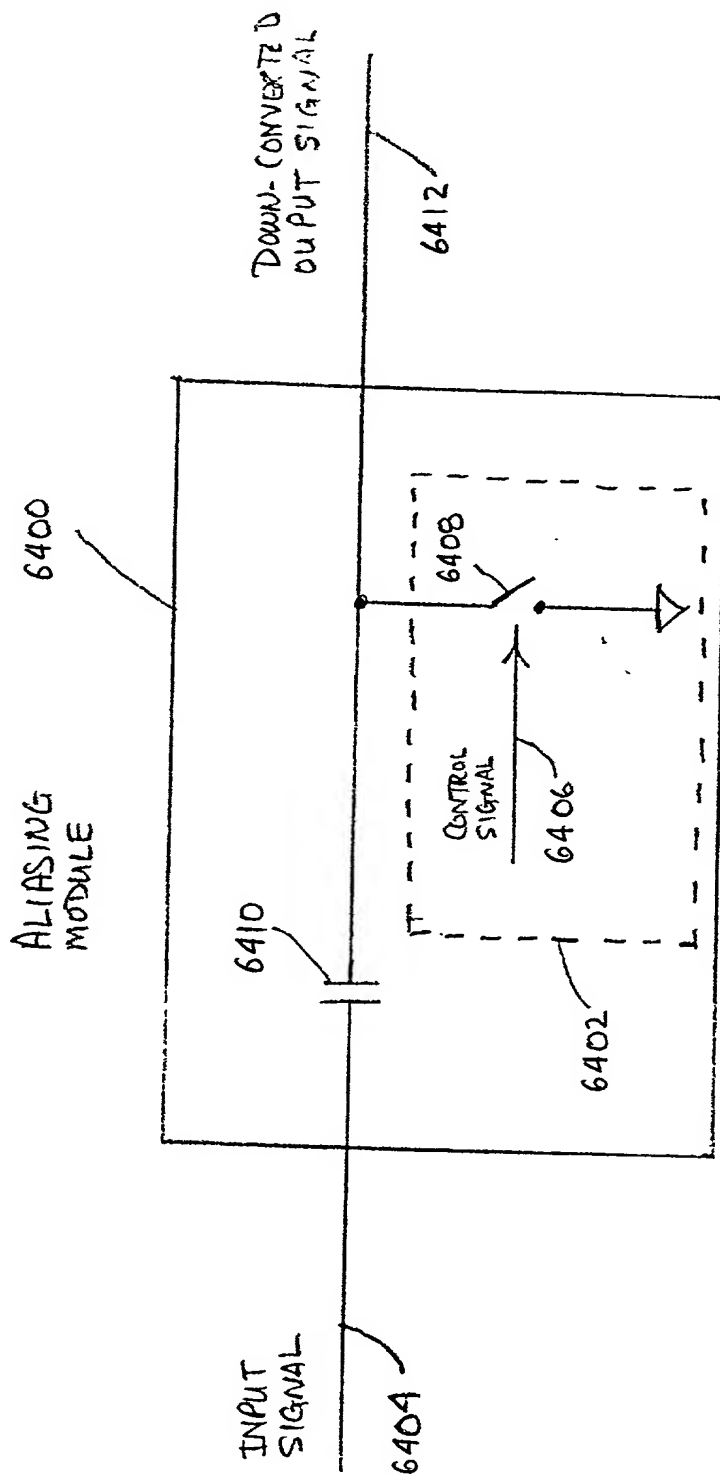


FIG. 64A-1

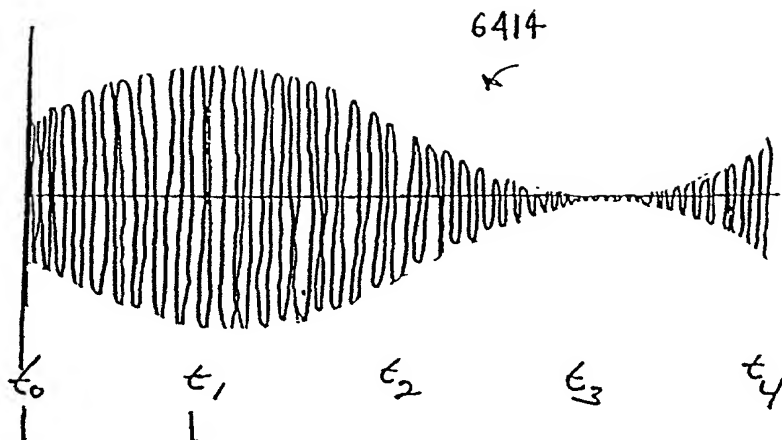


FIG. 64B

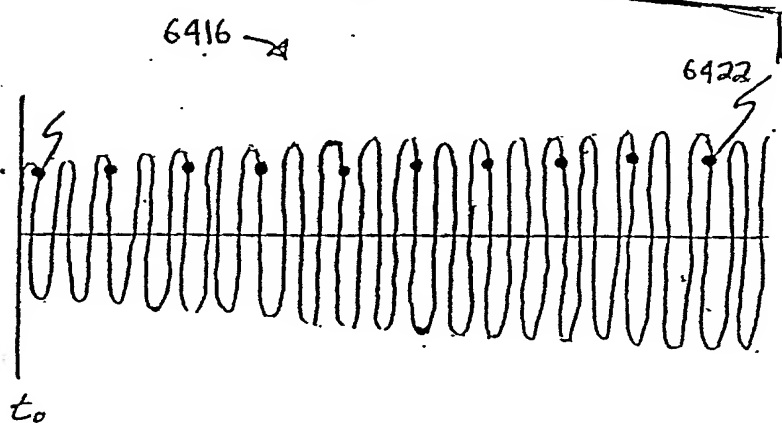


FIG. 64C

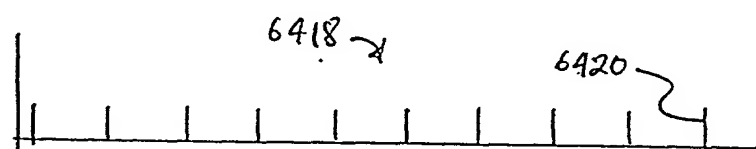


FIG. 64D

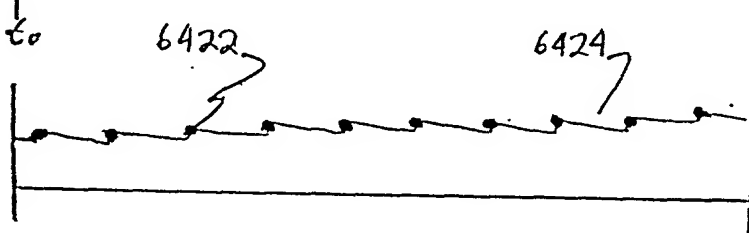


FIG. 64E

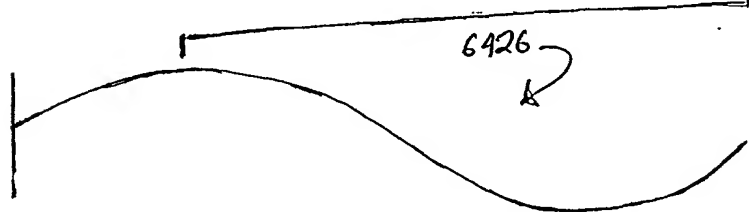


FIG. 64F

FIG. 64 (continued)